BRANCH CIRCUIT POWER METER

iSAST Wi-GEM

Wireless Green Energy Meter

USER MANUAL

J&D SMART SENSING

◆ Thank you for purchasing this product.

1. First of all, be sure to read this manual for correct use of the product.
2. If you find any missing contents or error, please inform us.
3. J&D electronics assumes no responsibility for any direct or indirect loss or damage which may occur through use of this product, regardless of any failure to perform on the part of this product.

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General Information

1. Certification related

This product has been designed to comply with the following standards and directives :

- IEC 61010_1 : 2001 (Safety Specification)
- FCC Part 15, Class B
- FCC Part 15, Class C

c UL us LISTED
Measuring Equipment
E344623
4YP9
CAT III

For more details, see this manual.

2. Labeling

The label including the model name, identification number and etc. is placed on the back cover, The identification number of each device is placed on the bottom center of the back cover.

3. Glossary

- Wi-GEM (Wireless Green Energy Meter) : Product name that consists of EMU, EMC, and EMR.
- EMU (Energy Meter Unit) : Energy meter that collects the required electrical parameters.
- EMC (Energy Meter Coordinator) : The network gateway.
- EMR (Energy Meter Router) : Router between EMU and EMC.
- RTC (Real Time Clock)
- Modbus : Communication protocol.
- L1/L2/L3/N : In case of 3-phase 4-wire, L1/L2/L3/N indicates the phases of power source. In case of 3-phase 3-wire, only L1/L2/L3 exist. In this manual, we use L1, L2, L3, and N.

4. Safety instructions

DANGER

If you do not follow the instructions in this manual, it may cause serious accidents.

- Only qualified persons from the manufacturer or agent must handle the inside components of the product.
- Owners, maintenance and service personnel, managers, operators, setters, programmers, foremen, mechanics, and all personnel related to these products must read and strictly follow the safety instructions in this manual.

Please read the following warnings and cautions to prevent injury or damage to the product.

DANGER

This symbol alerts that ignoring an instruction or incorrect action may cause a death or serious injury.

WARNING

This symbol alerts that ignoring an instruction or incorrect action may cause minor injury or damage to the product.

CAUTION

This symbol alerts that ignoring an instruction or incorrect action may cause a Product malfunction or data or property loss.

CAUTION

This symbol risk of electric shock.

This symbol means protective conductor terminal.

This symbol means alternating current.

This symbol means both direct and alternating current.

This symbol means direct current.

5. General description

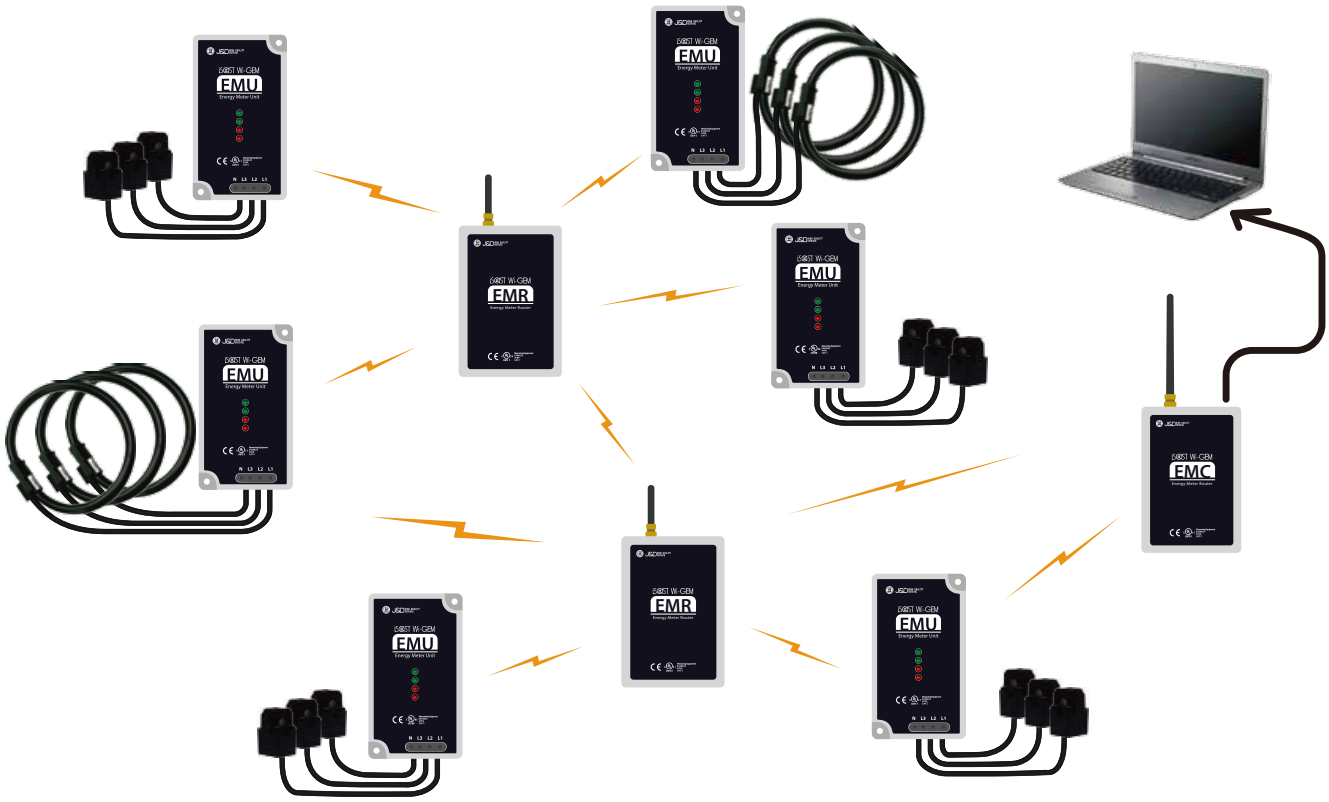


Figure 1.1 Communication Concept Diagram

To reduce power consumption or carbon emission, detailed power measurement for each process, line, and device is required.

By installing Wi-GEM, detailed power measurement is enabled. Wi-GEM also can perform the following :

- Measurement of voltage, current, active/reactive power, apparent power, power factor, and frequency
- Measurememt of peak power
- Simultaneous event monitoring and storing for instantaneous low-voltage and over-current

Because we open the Modbus protocol and register map for measurement, you can easily build your own system.

5.1 EMU (Energy Meter Unit)

EMU is the energy meter that collects the required electrical parameters at the specific interval after its sensors are fixed on the power cable. A single EMU can also be connected to a computer for analysis.

An EMU can have 2 sensors that measure the electrical parameters for 3 phase 3 wire (L1/L2/L3).

An EMU can have 3 sensors that measure the electrical parameters for 3phase 4wire (L1/L2/L3/N).

It can support wirings for single phase, 3 phasese 3 wires, and pases 4 wires.

Communication is possible by a single EMU or multiple EMUs.

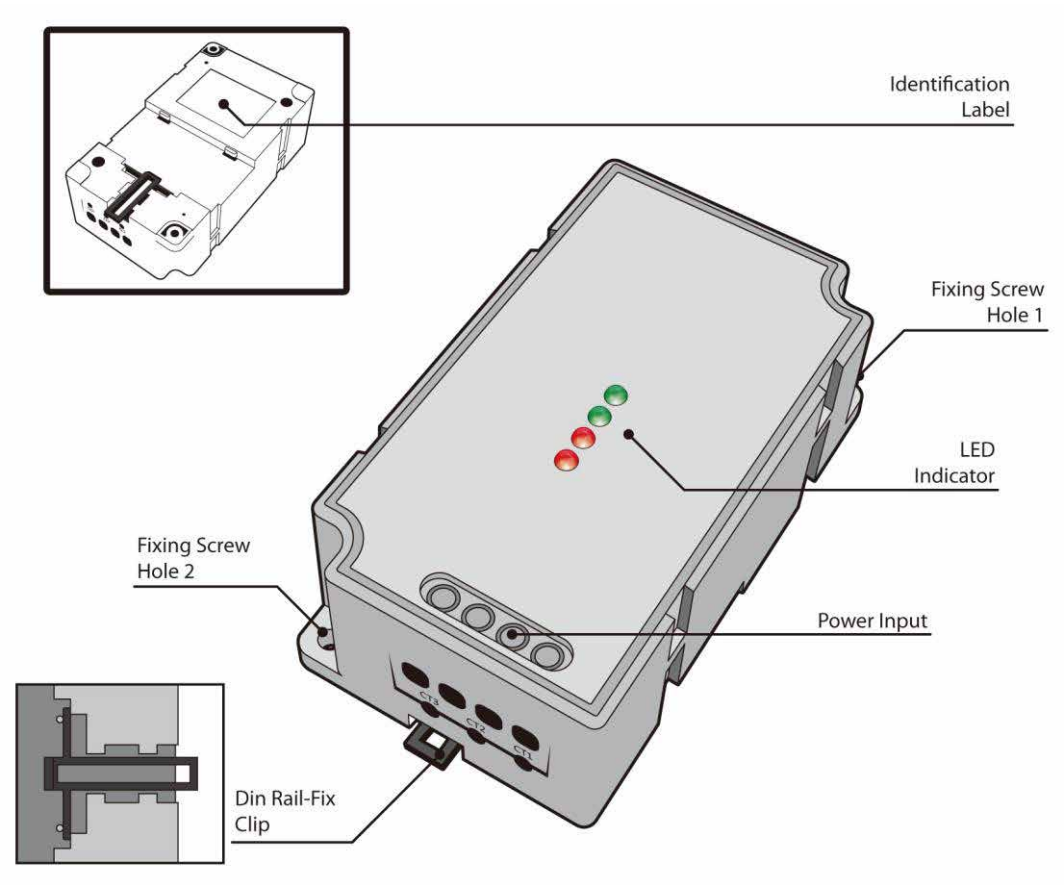


Figure 1.2 EMU Parts

NAME	DESCRIPTION
DIN Rail Fix Clip	To fix EMU onto a DIN rail, use this clip on back cover.
Fixing Screw Hole 1&2	To fix EMU on a wall of the distribution panel, insert screws in these holes and fasten them.
Product Label	The product label is placed here.
Indentification Label	The label si attached on the back cover. The ID can be set using the DIP switches or using a program. in case of using DIp switches, the maximum number of IDs is 63. With the program, maximum 255 IDs can be set while all DIP switches are off.
LED Indicator	It displays the current status. It can display various statuses.
Power Inputs	For 3 phase 4wire, Connect power input sources (L1, L2, L3, and N) For single phase, connect power input sources (L1, N) For 3 phase 3wire, connect power input sources (L1, L2, L3)
Zigbee	If EMU needs to be directly connected to a PC, use the RS485 connection port. Connect P+ and N- of EMU with the USB port on a PC via the connector. It supports Zigbee or RS485 communication.

Main features of EMU are as follows :

- Measuring instantaneous values for voltage, current, active power, reactive power, and apparent power of each phase
- Measuring accumulative values for active energy and reactive energy, apparent energy of each phase, and the total of each phase.
- Measurement of frequency : 50/60Hz
- Wide operating voltage : phase voltage 100 to 250 V~, L1-N
- Measurement of wide input voltages : Max. 250V Vrms, 3~, CAT III
- Measurement of input currents using the split core CT : 5A ~ 2500A
- Measurement of input currents using Rogowski coil : 250A ~ 5000A
- Power consumption : 2W
- Isolation : Isolation class II, IEC61010-1 CAT III Vrms

- Measurement category : CAT III
- Environment : Indoor use
- Ambient operating temperature : -10 to +55℃
- Ambient storage temperature: -25 to + 85℃
- Mass : 160 g
- Maximum altitude : 2000 m
- Pollution degree : I
- Degree of protection : IP2x
- 2.4 GHz wireless ZigBee module
- Data logging into a PC
- Time stamps for each transmission data
- Logging interval: 1, 2, 3, 5, 6, 10, 15, 30, 60 minutes
- Easy installation and DIN rail mounting
- Modbus protocol
- Economic price
- A management program to be developed at user's taste
- Voltage THD & Current THD
- Individual Harmonics

5.2 EMC (Energy Meter Coordinator)

EMC (Energy Meter Coordinator) is the gateway that controls the wireless network and periodically gathers the collected data from EMUs. It can be accessed by an application program for data analysis. The program shows the power-related values such as voltage, current, frequency, etc. It is connected with PC via the USB cable.

EMC has the following parts :

NAME	FUNCTION
Fixing Screw Hole 1&2	To fix EMC on a wall, insert screws in these holes and fasten them.
Antenna	Used for wireless communication.
DC Jack	5V DC (노란색 표기의 의미)
RJ45 Connector	Used to connect EMC with a PC. EMR does not have this port.
Product Label	The product label is placed.

Figure 1.3 EMC

5.3 EMR (Energy Meter Router)

EMR is the router that relays the data between EMU and EMC. It is automatically detected by an EMC. An EMC can connect EMRs up to 255 logically.

EMR has the same shape as EMC except for USB connection port to a PC. EMR has no connection port. The adapter that is used to supply power must have been evaluated by UL. The DC power to EMR can use the DC adapter for 5 to 9 V.

5.4 Handling multiple EMUs using Zigbee

If multiple EMUs need to be monitored and controlled, the collected data can be transferred to a wireless EMR via the wireless Energy Meter routers (EMR) as shown in Figure 1.1. Otherwise, an EMR is directly connected to an EMU.

Each individual EMU has its own unique ID that can be set using the DIP switches inside EMU. Otherwise, users can use the factory default settings.

The network communication has been implemented following the ZigBee specification. The communication features are:

- RF wireless frequency : 2.4 GHz
- IEEE 802.15. 4 compliant radio
- RF Data rate : 250 kbps
- Indoor Range : up to 60 m
- Outdoor RF line-of-sight Range : up to 1500m
- Transmit output power : 10mW
- Receiver Sensitivity : -102dBm

Available network configurations are :

- Single path network topology : EMC is connected to an EMR (with an EMU) that is connected to another EMR (with an EMU).

- Star-network topology : EMC is connected to multiple EMUs.

- Mesh network topology

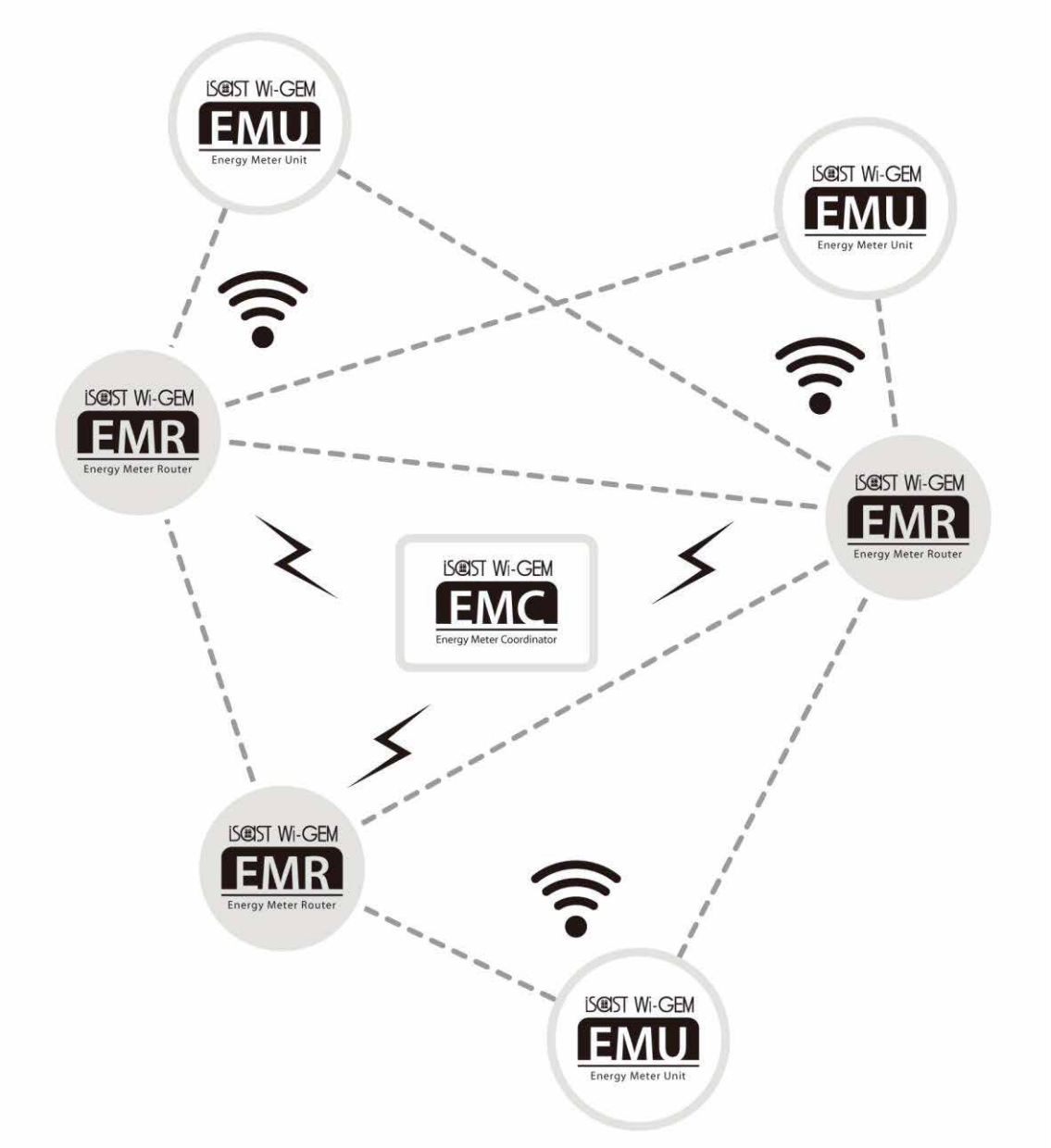


Figure 1.4 An Example of Mesh Network Topology

Installing and Configuring Hardware

1. Before installation

DANGER	Electrical shock or fire! This product can cause serious injury or death to persons if the instructions are not cautiously kept.
CAUTION	Follow the standard specifications and safety requirements.
CAUTION	Do not cut or forcibly pull the cabels.
WARNING	Only qualified persons must install the product.

First of all, be sure to familiar with this manual.

Perform the following suggestions for correct installation.

- If multiple EMUs are required to be installed, plan the layout of EMUs. For this purpose, think over the network topology and fixing method.
- Check whether any other interference generating devices exist or not. If so, relocate the installation location.
- Check whether the rated voltage and current on the label are correct.
- Install the product to the place that is not affected by strong magnetic field for correct operation and precision.
- The temperature must be within the operation temperature range. Do not install the product outdoors.
- The upper or lower clamp must be kept clean for correct operation and precision.
- Install the product following the instructions in this manual. An arbitrary installation may cause damage to the product or personal injury.
- Do not keep four side locks and power input terminal blocked for ventilation flow.

2. Installing EMU

DANGER	During EMU installation, be sure to turn off the power.
CAUTION	Do not apply physical damage to the product. If the clamp is separated or its insulation tube is stripped, it may cause infury or death.
CAUTION	Only qualified personnel must install EMU.
WARNING	Be sure to install EMU in the distribution panel with an additional lock. The EMU must be installed in a suitable rated UL Listed fire/electrical distribution panel(enclosure).Only the qualified personnel who follow standard safety precautions during all procedures must access the distribution panel. Those personnel should have appropriate traning and experience with high voltage devices. Appropriate safety gloves, safety glassed and protective clothing are recommended.
CAUTION	Be sure to follow the instruction in this manual during installation. Keep the specified specifications and regulations.

2.1 Detailed Description

Data from the meter is sent to the gateway for uwer access periodically.

The meter data is split into three sections :

- **Energy Meter :** Active, reacive and apparent evergy per phase and sum with a time-stamp.
- **Recording interval meter :** Active, reactive and apparent energy per phase and sum with a time-stamp of the end of the recording interval; minimum voltage per phase and maximum current per phase during recording interval; frequency
- **Meter Identification and Configuration :** Meter configuration and version; recording inteval time setup, command and status word.

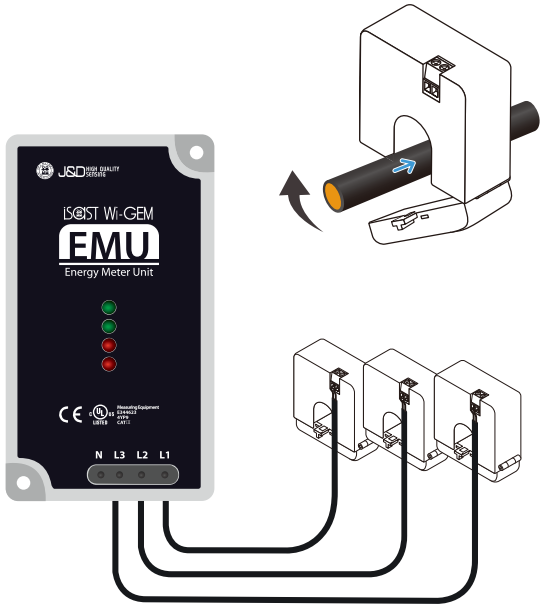


Figure 1.5 : Energy Meter Node built with RT

2.2 Models Description

1) Basic guidelines

To obtain the best effectiveness of the network, apply the following recommendations.

- Do not install EMN in front of or close to metallic parts. That may reduce the efficiency of the embedded atenna.
- Avoil proximity of Electromagnetic Induction.
- Respect the illustrated layout to insure an optimized orientation of the antenna.

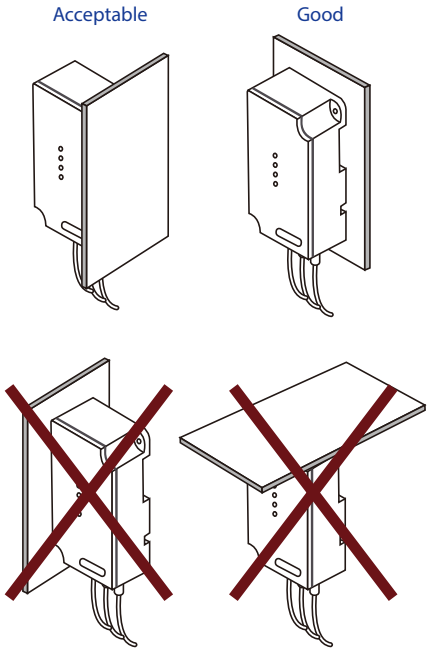


Figure 1.6 : Avoid the proximity of the antenna with metal parts

2) Inside a metallic cabinet

When EMN has to be placed inside a metallic cabinet, its location is even more important.

The cavinets are never completely sealed thanks to small open spaces and allow certain radio communication, but significantly reduce signal strength. To get the best effectiveness, apply the following recommendations :

- Do not install EMN in the centre of the cabinet where most electrical cabels are located.
- Put EMN on one side, in front of any door slit or any window (If existing).
- If there is moe hole on bottom or top of the cabinet for cables pathways, put EMN in front of it.
- Add systematically a Mesh Node in the vicinity of the cabinet (1m) to ensure robust communications.

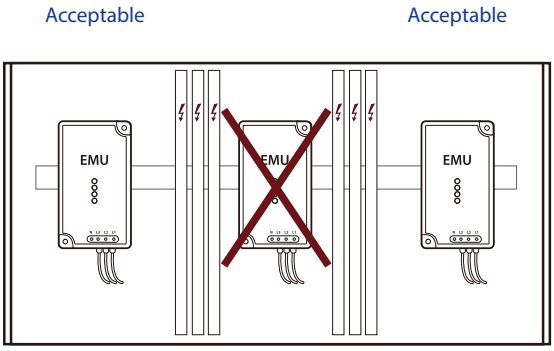


Figure 1.7 : EMU Location inside a metallic cabinet

3) Mesh Node location and connection

Orientation of the nodes in relation to toher devices on the network impacts radio signal strength.

- Avoid placing Mesh Node right under an EMU.

WARNING

TAKE CARE IF FIXING MEST NODE HORIZONTALLY ON A METALLIC PLANE TO LET A MINI-MUM FREE INTERVAL (3-5MMS) BETWEEN BOTH AREAS IN REGARDS.

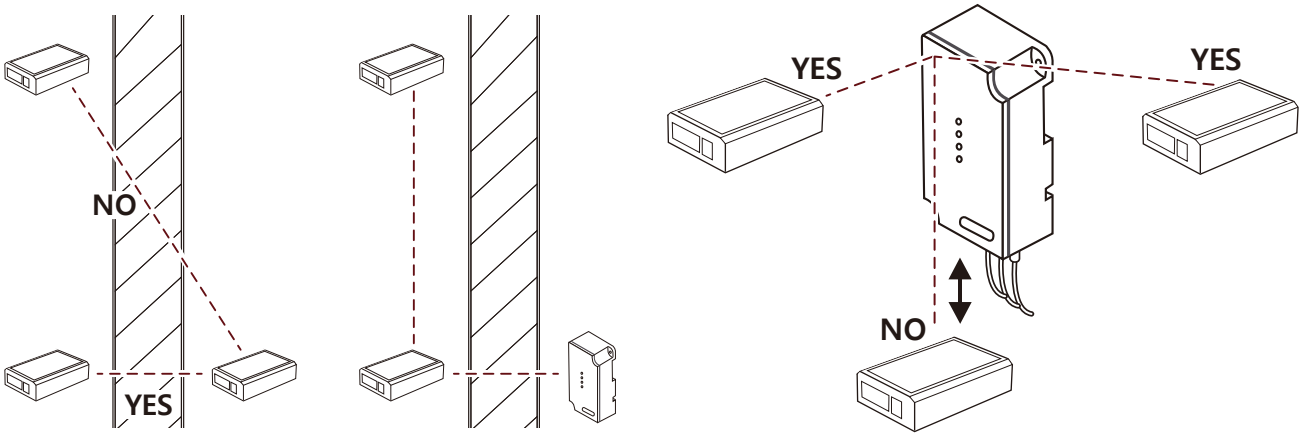


Figure 1.3 : Location advising

Best radio signal is observed when all Mesh Node devices are positioned horizontally :

Good radio signal is also observed when one device is positioned horixontally and toher vertically :

Radio signal is weaker, when all devices are positioned vertically :

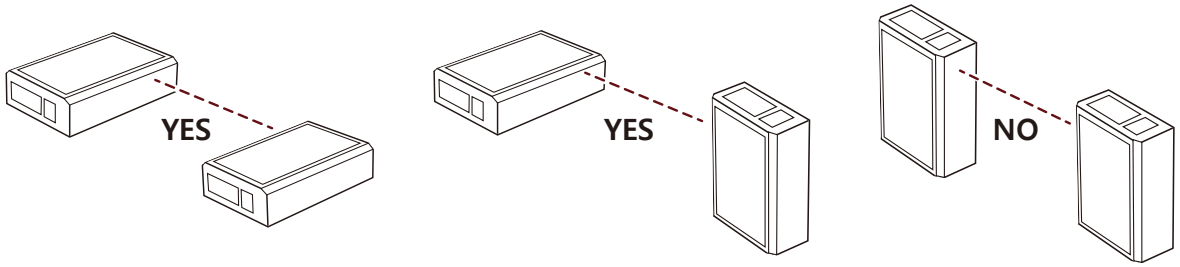


Figure 1.3 : Devices position

2.3 Installing the EMU body

To keep effective wireless network communication, do not install EMU in front of interference generating materials or metal surfaces. If the embedded antenna is close to the material, it can decrease the efficiency of the embedded antenna.

To mount the EMU on the wall, perform the following steps :

1. Prepare two screws.
2. Insert screws in the holes shown in Figure 1.2 and fasten them with a screwdriver.

To mount the EMU onto a DIN rail, perform the following steps :

1. Insert the EMU onto the DIN rail and move it to a desired position.
2. Pull up the fix clip to fix the EMU.

The Following figure shows an example of correct installation.

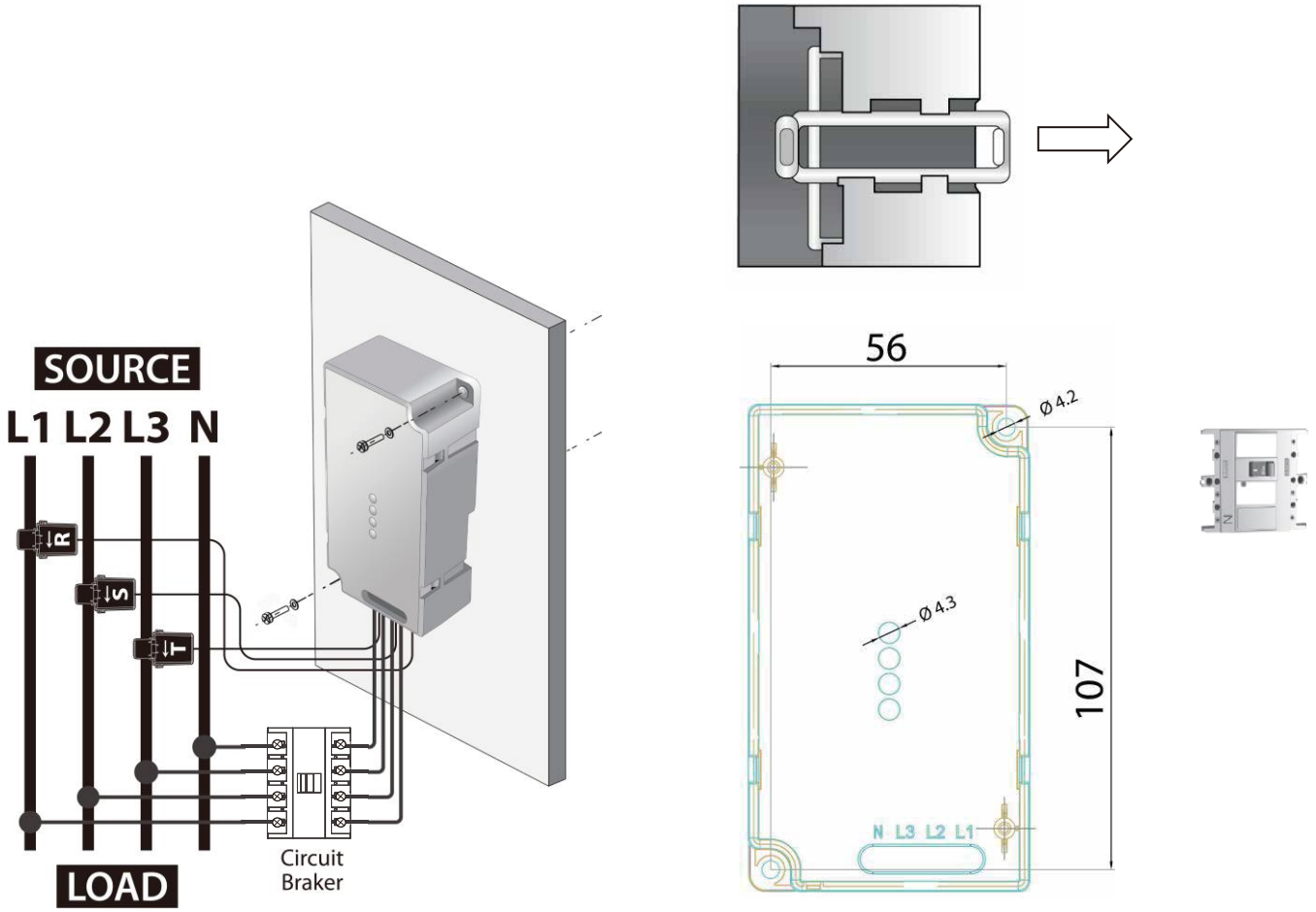


Figure 2.1 Correct EMU Installation

2.4 LED display of EMU

EMU has an LED lamp to display the current status as explained below :

STATUS	DESCRIPTION
Run LED	EMU operates in normal mode(fast flashing)
Comm. LED	EMU is performing the TX/RX communication
WH LED	Active Energy Pulse
VarH LED	Reacive Energy Pulse

CAUTION

If the green lamp does not blink after power supply, see 5. Troubleshooting and take a specified action.

2.5 Setting EMU ID and Baud rate

DANGER

Only the qualified personnel from the manufacturer or agent must set the EMU ID and baud rate.

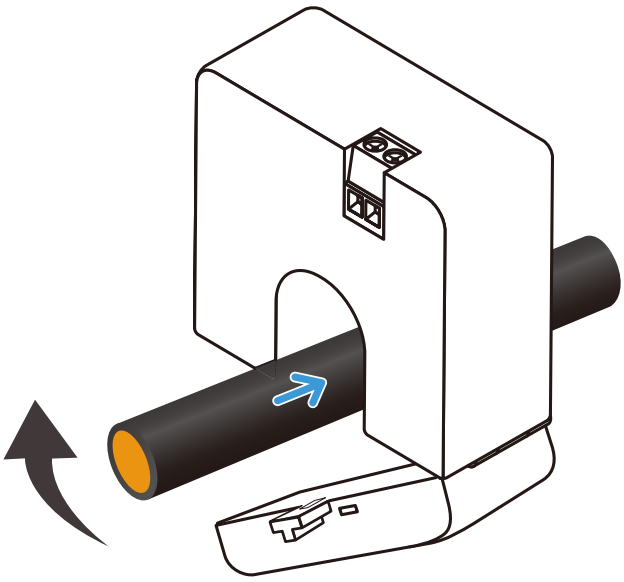
2.6 Mounting sensors

The sensor that measure electrical parameters are connected to an EMU. The sensors are fixed on power cables. so please keep the following cautions :

DANGER	The clamp must be attached to the wire with 300 V insulation capability.
CAUTION	Before installing a sensor, please check no current flows into the cable.
CAUTION	Clean the surface of the cable. Otherwise, foreign materials can cause a malfunction or incorrect measurement.
CAUTION	If phase allocation is wrong, incorrect energy data will be collected.
CAUTION	The allowable number of clamp openings is 50 times or below. Frequent clamp openings may shorten the life of clamp.

To mount a sensor on the target cable, perform the following steps :

1. Place the sensor on the target cable according to the specified phase.
2. Keep the direction of the arrow sign on the sensor same as the current flow direction.
3. Close the sensor clamp over the cable.
4. To fix the sensor on the cable, use the cable tie.

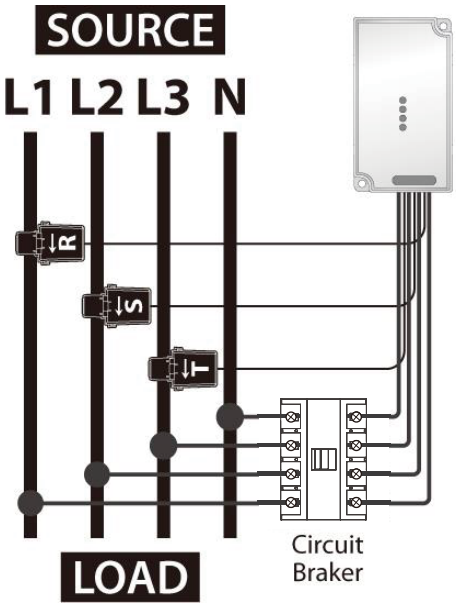


2.7 Connecting voltage wires

Now, connect the wires to the power input points (L1, L2, L3, N) at the bottom panel of EMU.

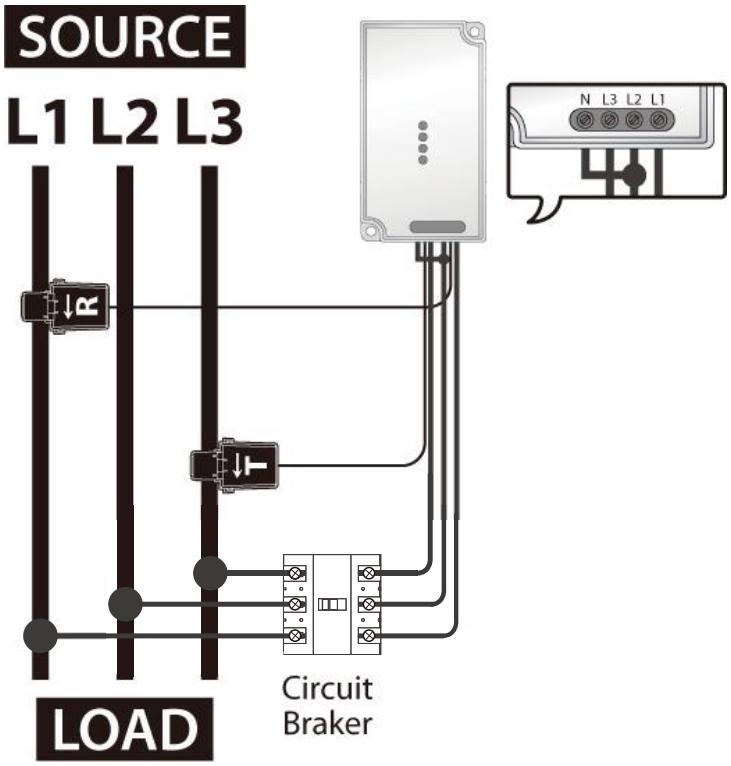
CAUTION	Before connection, be sure to check no current flows into the wires.
CAUTION	The wire must have been covered by the tube with 300 V insulation capability. The size of the conductor must be within the range of1.0 to 6.0 mm^2 (17 AWG to 10 AWG).
CAUTION	For supply connection, use wiring materials suitable for at least 75℃.
CAUTION	Make sure that connection of power supply should have provision for connection of one of the wiring system in accordance with the National Electrical Code, ANSI/NFPA 70, NEC, with CSA C22.1, CEC, Part I or with both as appropriate.
CAUTION	For protection, the circuit breaker must be installed between the voltage wire and power. The maximum rating of circuit breaker is 20A, then minimum size of branch circuit wiring will be used with 12 AWG.

The following explains how to connect the wires for each case.

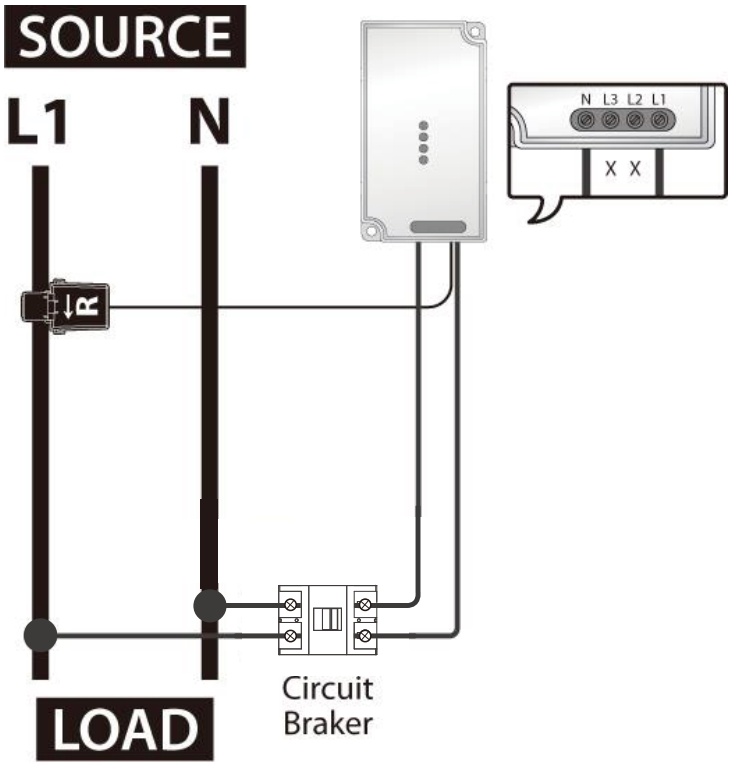


Wiring for 4 phases 3 wires

Wiring for 3 phases 3 wires



Wiring for Single phases 2wires



3. Installing EMRs and EMC

According to the prepared topology plan, install EMRs near the installed EMUs. Then install EMC near the monitoring computer.

Power connection to EMR

USB connection to EMC

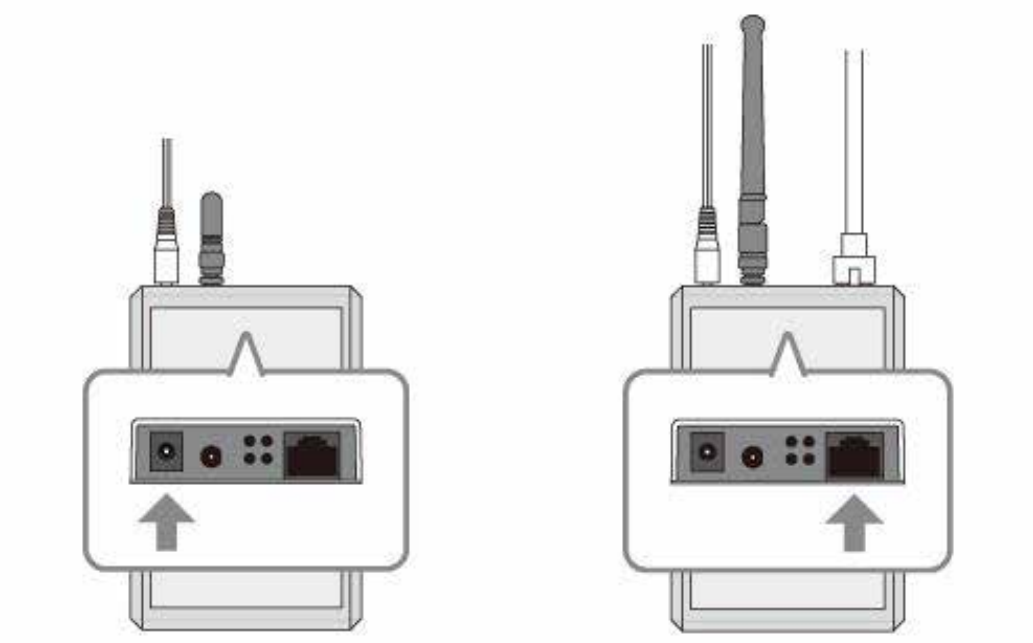


Figure 2.2 Installation of EMR and EMC

4. Connecting EMC to PC

EMC is configured for the MODBUS protocol. when the EMC is turned on, the network starts building the structure. It may take a while.

For connection between EMC and PC, EMC has a RS232 port on it by RJ45. If there is no RS232 port on PC, Use a USB Serial Converter for Comm.

The pin numvers for RS232 port cabling are below

RS232 Port(RJ45)

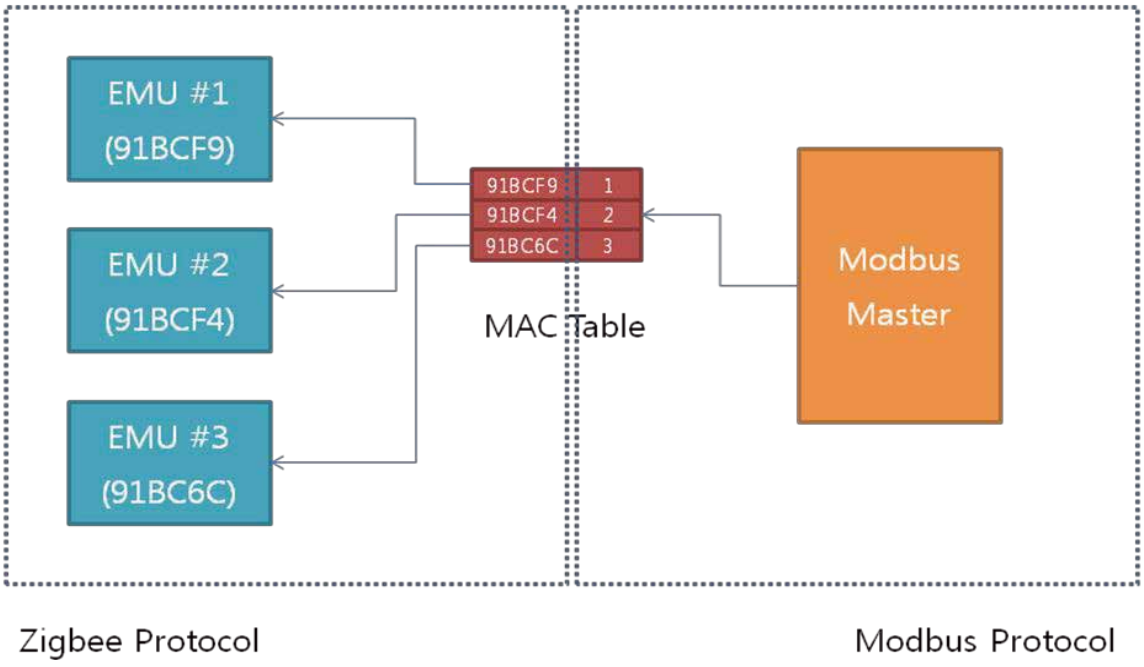
Signal Name	Pin Number
TX	4
RX	5
GND	3, 6

The serial port settings of modbus master are below for Modbus RTU protocol communication.

Signal Name	Pin Number
TX	4
RX	5
GND	3, 6

5. Installing the MMI software and Settings

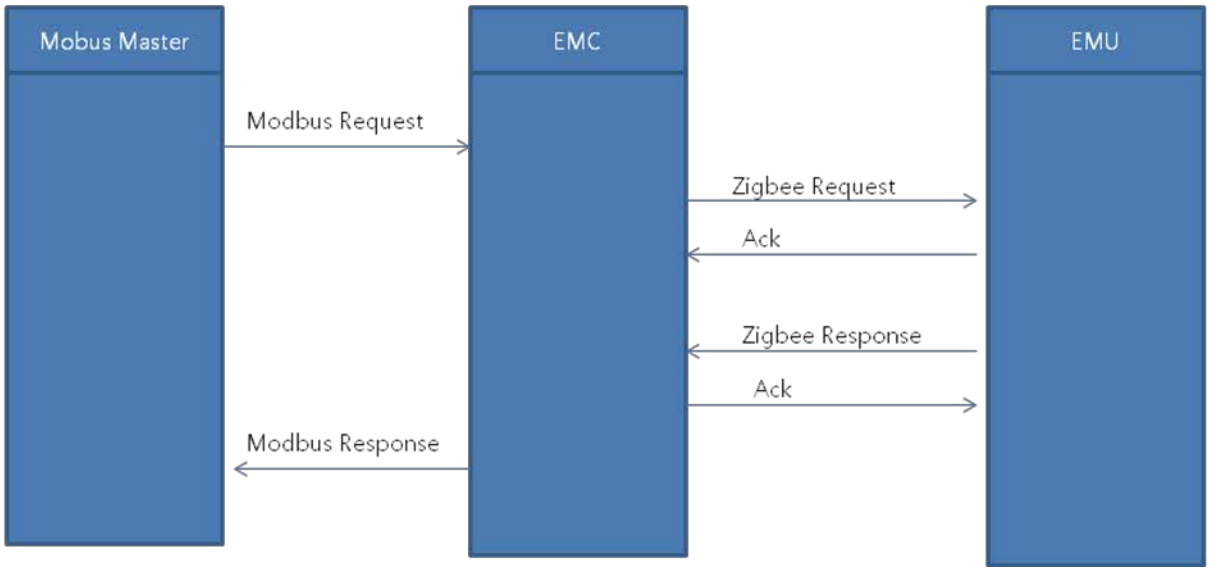
The diagram below shows the protocol transformation concept between Zigbee and Modbus protocol.



5.1 Setting of the address table.

1) Editing Mac address.

EMC is a device acts as a MODbus gateway. it relays the protocol between Modbus protocol and Zigbee protocol. All EMUs are allocated with its own MAC addresses. It is written on the label of EMU. To read the data of EMU with Modbus protocol, it needs to transform the Modbus address into MAC address. EMC performs it's process using the internal address transformation table.



The transformation table includes MAC address area, Modbus address area and the name area to be able to distinguish the EMU each. Input the MAC address first and then input the Modbus address and the name responding to it one by one.

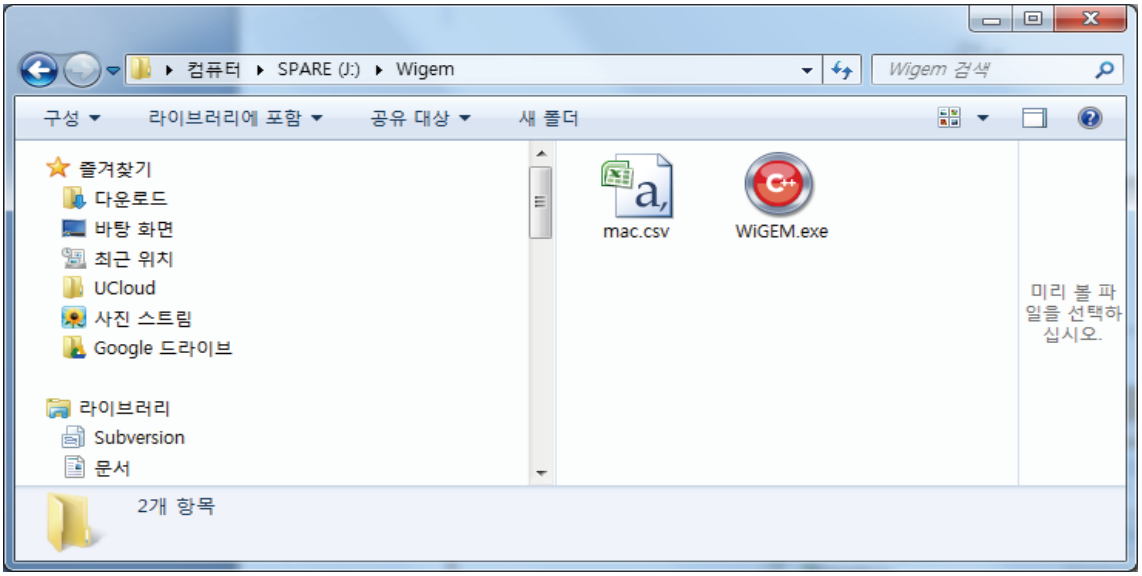
For example, if the MAC address is "91BCF9", the Modbus address is "1", and the name is "EMU#1", the table forms as 91, BC, F9, 1, EMU#1.

91	BC	F9	1	EMU#1
91	BC	F4	2	EMU#2
91	BC	6C	3	EMU#3

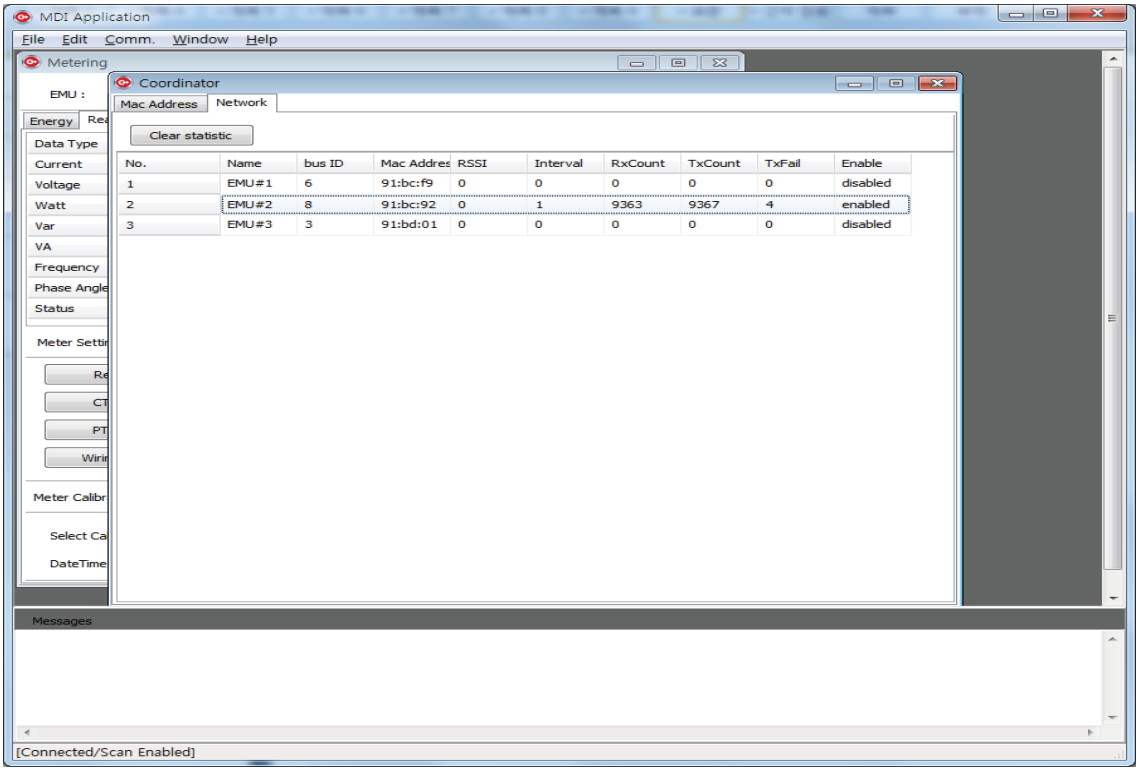
After input the addresses and store it with ".csv" ilename extension.

2) Import

After making a "mac.csv" file in the folder which the MMI software is installed, run the MMI software "Wigem manager' by clicking the program icon WiGEM. When it is loaded, it reads the "mac. csv" file and displays the contents on the window automatically. The "coordinator window" displays MAC address, Modbus address, EMU name on the "MAC Address" table.

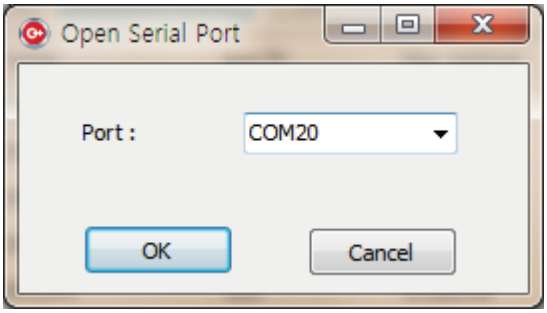


In case of reading a "mac.csv" file again during the MMI software running. Run the [File-Reload Mac File] menu.

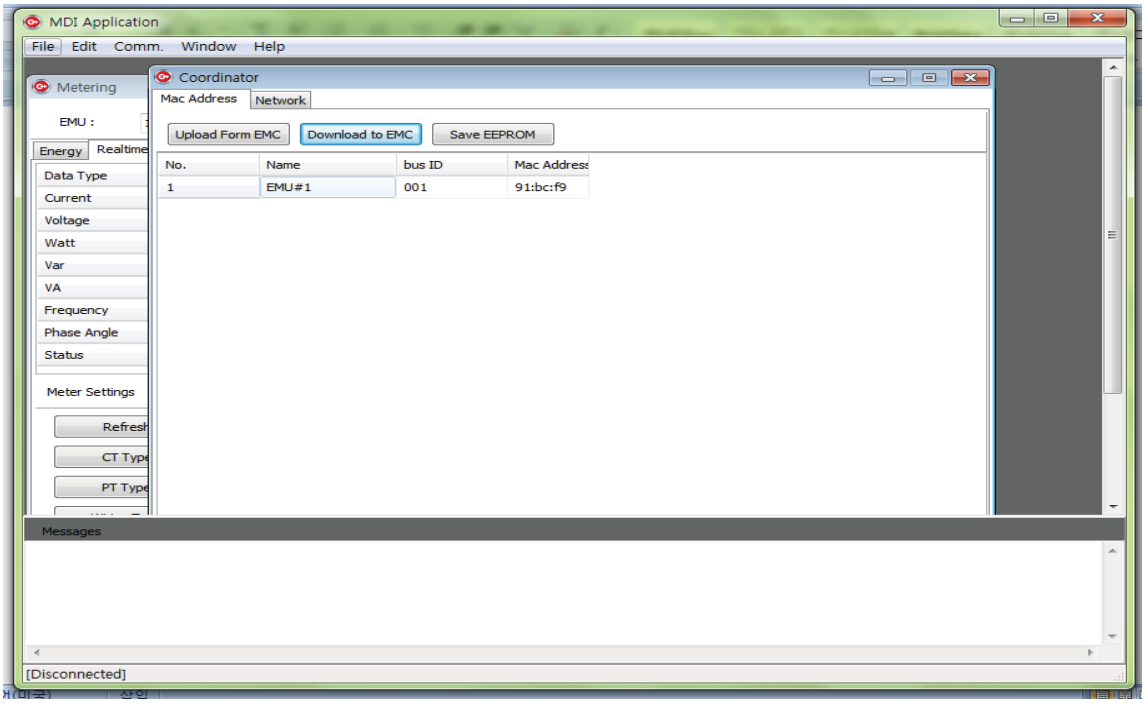

MDI Application
File Edit Comm. Window Help
Metering
Coordinator
Mac Address
Network
Clear statistic
No. Name bus ID Mac Addres RSSI Interval RxCount TxCount TxFail Enable
1 EMU#1 6 91:bc:f9 0 0 0 0 0 disabled
2 EMU#2 8 91:bc:92 0 1 9363 9367 4 enabled
3 EMU#3 3 91:bd:01 0 0 0 0 0 disabled
Messages
[Connected/Scan Enabled]

3) Download

To transfer the MAC address impoted to the EMC, click the [Comm.-connect] menu. Then the “Open Serial Port” window pops up. Select a com. port and click O.K button and the communication port is opened.



After select the “MAC address” tap at the “Coordinator window” and push the “Download to EMC” menu button. When the download is completed, the “Download Success” message displays on the “Message”



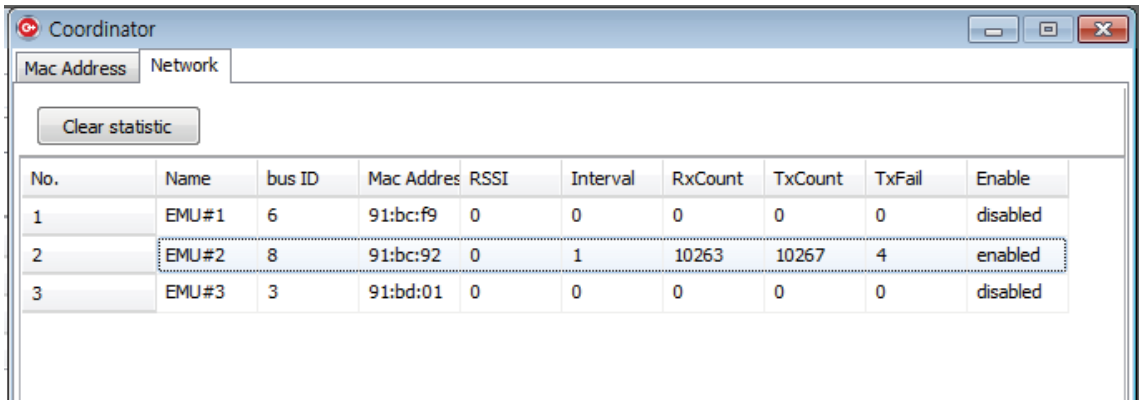
4) Upload

It uses the MAC address stored in the EMC. When click the “Upload From EMC” menu button, It displays the MAC address read on the table. EMC does noto store the device name and reserves it as blank.

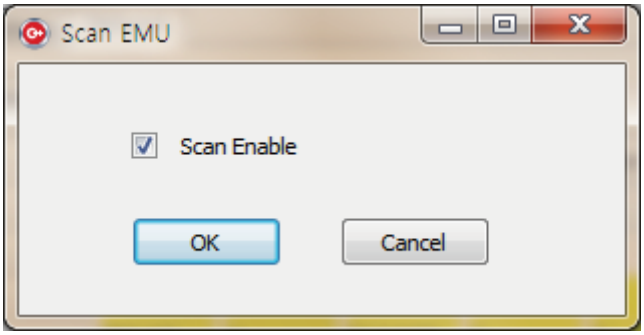
5.2 Communication Monitoring

1) When click the [Comm.-Enable Scan] menu at the Main menu, it requests the data in the table on by one in order When click the [Comm.-Disable Scan] menu at the Main menu, it stops all communication with EMU.

2) When click "Network" menu tab at the "Coordinator window", it shows sending and receiving count, fail count on the table.


Coordinator
Mac Address
Network
Clear statistic
No. Name bus ID Mac Addres RSSI Interval RxCount TxCount TxFail Enable
1 EMU#1 6 91:bc:f9 0 0 0 0 0 disabled
2 EMU#2 8 91:bc:92 0 1 10263 10267 4 enabled
3 EMU#3 3 91:bd:01 0 0 0 0 0 disabled

- Tx Count : Whenever it sends the request fraim, it counts up one by one.
- Rx Count : Whenever it receives the response fraim, it counts up one by one.
- Tx Fail : It is sum of subract Rx Count from Tx Coun. Whenever the communication fails, it increases the number one by one.
- Enabled : It displays the status of EMU each. If it is at no scan status, it displays it by "Disabled" and displays it by " Enabled" at scan staus. When it stops and activates the Comm. for a designated specific EMU, double click the row of EMU in the table and pops up the "Dialog window" as like below. If it needs to stop the Coom., check off it in the small check bos. and click O.K button, and then the background color of the EMU changes into "yellow" and stops scanning.



RSSI : Displays the receiving radio signal intensity of EMU.

Interval : Displays the Recording Interval of EMU.

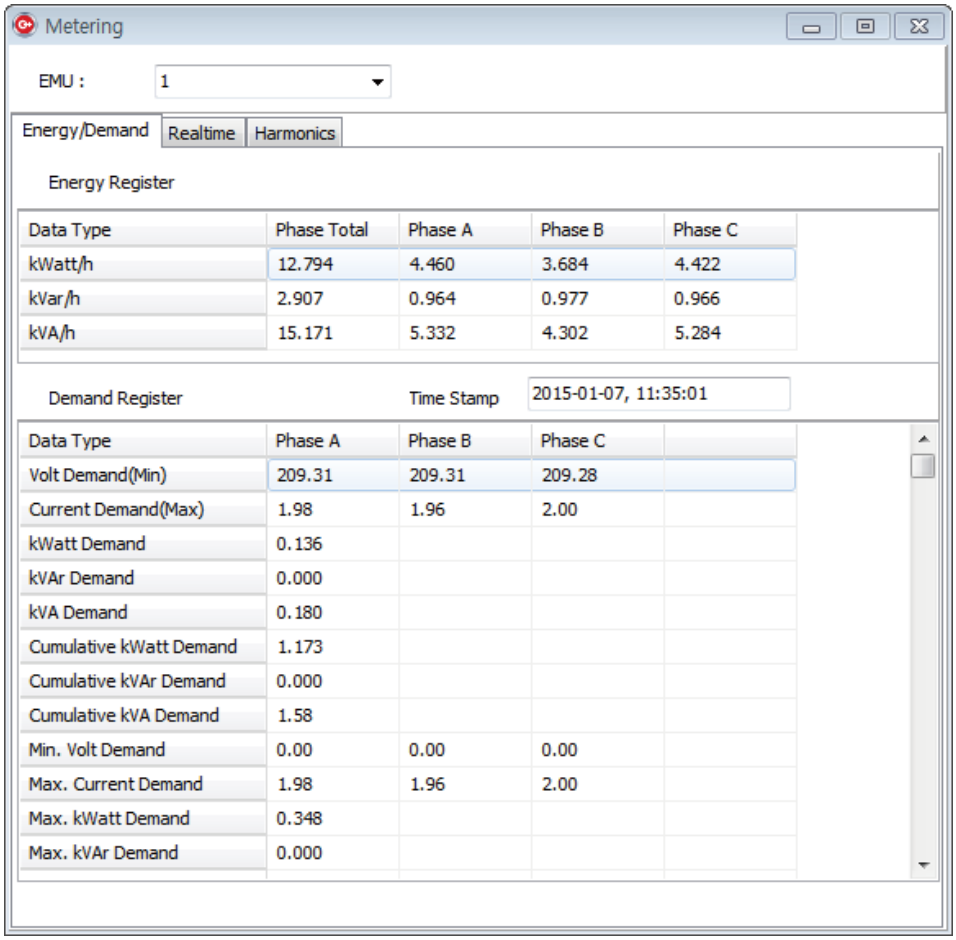
5.3 EMU

1. LED

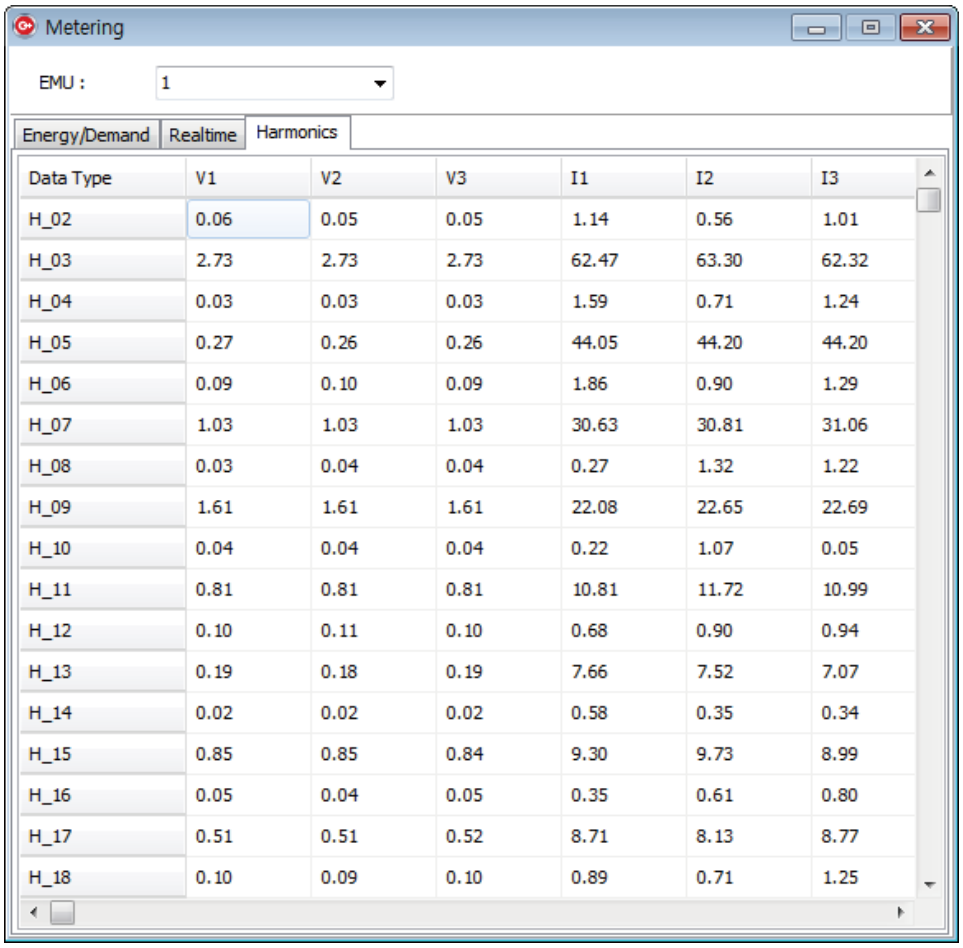
RUN	The LED is flickering in normal status
Comm.	When it joins Zigbee network, the LED turns on. When it activates Comm. the LED is flickering.
WH	Active Energy Pulse
VarH	Reacive Energy Pulse

2. Measurement

1) Select the "Metering Window" and EMU to be monitored in the Combo box.

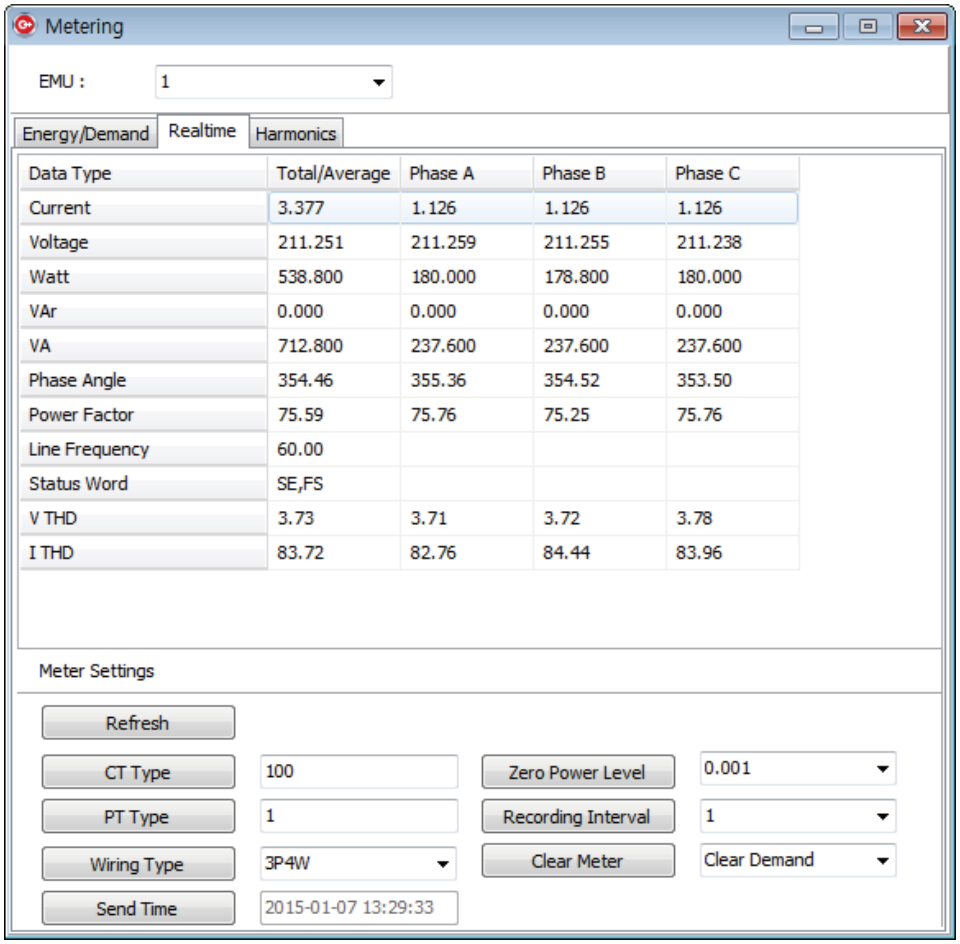


2) Select the "Metering Window" and Harmonics to be monitored in the Combo box.



Data Type	V1	V2	V3	I1	I2	I3
H_02	0.06	0.05	0.05	1.14	0.56	1.01
H_03	2.73	2.73	2.73	62.47	63.30	62.32
H_04	0.03	0.03	0.03	1.59	0.71	1.24
H_05	0.27	0.26	0.26	44.05	44.20	44.20
H_06	0.09	0.10	0.09	1.86	0.90	1.29
H_07	1.03	1.03	1.03	30.63	30.81	31.06
H_08	0.03	0.04	0.04	0.27	1.32	1.22
H_09	1.61	1.61	1.61	22.08	22.65	22.69
H_10	0.04	0.04	0.04	0.22	1.07	0.05
H_11	0.81	0.81	0.81	10.81	11.72	10.99
H_12	0.10	0.11	0.10	0.68	0.90	0.94
H_13	0.19	0.18	0.19	7.66	7.52	7.07
H_14	0.02	0.02	0.02	0.58	0.35	0.34
H_15	0.85	0.85	0.84	9.30	9.73	8.99
H_16	0.05	0.04	0.05	0.35	0.61	0.80
H_17	0.51	0.51	0.52	8.71	8.13	8.77
H_18	0.10	0.09	0.10	0.89	0.71	1.25

2) The Measurement information of EMU is displayed in the “Energy” tab and “Realtime” tab devided.



3) Energy Data

MMU software “Wi-GEM Manager” shows the data below.

- Energy Register
  - Active Energy : Displays Active Energy of each phase and total. The unit is Watt/h
  - Reactive Energy : Displays Reacive Energy of each pahse and total. The unit is Var/h
  - Apparent Energy : Displays Apparent Energy of each phase and total. The unit is VA/h.

  Time Stamp : Displays the updated time of the Energy Register newly.

- Unit range is 0 ~ 999,999,999.

- Recording Interval

It measures the Energy in a certain period of time. The ime units to be set are 1, 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 minutes. It criteria of time is based on the internal timer of EMU. When it time is up, EMU stores the gathered data in the "Recording Interval Register" and initializes it.

- Active Energy : Displays Active Energy of each phase and total. The unit is Watt/h.
- Reactive Energy : Displays Reactive Energy of each phase and total. The unit is Var/h.
- Apparent Energy : Displays Apparent Energy of each phase and total. The unit is VA/h.
- Time Stamp : Displays the updated time of the Recording Interval Register newly.

- Demand Register
  - Max. Active Power, Time Stamp
  - Max. Reacive Power, Time Stamp
  - Max. Apparent Power, Time Stamp

It records the maximum power value after comparing the present on and the prior one, whenever the "Recording Interval data" is generated. And it records the time simultaneously.

4) Real Time Data

- RMS Value : Voltage, Current
- Power : Active, Reactive, Apparent
- Frequency
- Phase Angle
- Status : The value becomes "1", when the frequency o voltage engaged to EMU is in the range of 45~65Hz.
- RSSI : The receiving radio signal intensity.
- Recording Interval : It defines the time for the each section. It set the value by divisor of 60minute. For example, it becomes 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60.
- CT Ratio : Input the primary CT rating raitio. For example, if the CT rating current is 100A, Input the value of 100. CT should be used with the designated one made by manufacturer.
- PT Ratio : If the EMU is connected to a PT for a high voltage application, Input the PT ratio. In case of direct connection, it displays by "1"
- Zero Power Level : The threshold value to define the unload status of power.

Software Interfaces

To program a customer specific application, the following software developmetn data is required.

1. EMU related

1.1 Parameters and functions

The related parameters and functins are :

MODEL			Wi-GEM
Power system			1P2W, 2P3W, 3P3W, 3P4W
Inputs Rating	Voltage		90 ~ 264 VAC (Line to Neutral) 90 ~ 264 VAC (Line to Line for 3P3W) 156 ~ 457 VAC (Line to Line for 3P4W)
	Current	Primary	with Split core CT : 50 ~ 2,400A with Rogoskii coil CT : 250 ~ 5,000A
		Secondary	100mA/100mV (CT secondary side)
	Frequency		45 ~ 65 Hz
	Accuracy		1.0 Class
	Power Consumption		Less than 2W
	Communication		ZigBee (250 kbps)
Operation Temp.			-10 C ~ 55 C
Storage Temp.			-25 C ~ 70 C
Standards			IEC 62052-21

Measurement

Item		Unit	Digit	Remark
Real time	Phase voltage	V	Floating point	1P2W, 2P3W, 3P4W
	Line voltage	V	Floating point	3P3W
	Line current	A	Floating point	
	Active power	W	Floating point	Phase
	Reactive power	Var	Floating point	Phase
	Apparent power	VA	Floating point	Phase

	Frequency	Hz	45.00 ~ 65.00	
	RSSI	dB	0 ~ 255	Signal intensity
	Pahse angle	degree	0.00 ~ 360.00	Between Voltage and Current
	Active Energy	WH	0.0 ~ 999,999,999	Phase, Total
	Reactive Energy	VarH	0.0 ~ 999,999,999	Phase, Total
	Apparent Energy	VAH	0.0 ~ 999,999,999	Phase, Total
Interval Recording	Active Energy	WH	0.0 ~ 999,999,999	Phase, Total
	Reactive Energy	VarH	0.0 ~ 999,999,999	Phase, Total
	Apparent Energy	VAH	0.0 ~ 999,999,999	Phase, Total
	Max Current	A	Floating point	Phase
	Min Voltage	V	Floating point	Phase
	Average PF	%	0.00 ~ 100.00	
	THD	%	0.00 ~ 100.00	Harmonics reactive power
Demand Power	Max Active power	W	Unsigned int 32bit	Total
	Max Reactive power	Var	Unsigned int 32bit	Total
	Max Apparent power	VA	Unsigned int 32bit	Total
	Time stamp		Sec, Min, Hour, day, Month, Year	
	Recording Interval time	%	0.00 ~ 100.00	

1.2 Modbus commands

The commands used in the Modbus register map are :

Read holding register (0x03)

Write single register (0x06)

Write multiple register (0x16)

1.3 Modbus register map

* MSW : Most Significant Word, LSW : LeastSignificant Word

* NV : Non-volatile, V : Volatile, S : Signed, U : Unsigned, R : Read, W :

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
Meter Data						
0	Current, Phase 1	4	A	2	FLOAT	
2	Current, Phase 2	4		2	FLOAT	
4	Current, Phase 3	4		2	FLOAT	
6	Current, Phase Total	4		2	FLOAT	
8	Reserved	4		2	FLOAT	
10	Reserved	4		2	FLOAT	
12	Voltage, Phase 1	4	V	2	FLOAT	
14	Voltage, Phase 2	4		2	FLOAT	
16	Voltage, Phase 3	4		2	FLOAT	
18	Voltage, Phase Total Average	4		2	FLOAT	
20	Watt, Phase 1	4	WATT	2	FLOAT	
22	Watt, Phase 2	4		2	FLOAT	
24	Watt, Phase 3	4		2	FLOAT	
26	Watt, Phase Total	4		2	FLOAT	
28	Var, Phase 1	4	VAR	2	FLOAT	
30	Var, Phase 2	4		2	FLOAT	
32	Var, Phase 3	4		2	FLOAT	
34	Var, Phase Total	4		2	FLOAT	
36	VA, Phase 1	4	VAR	2	FLOAT	
38	VA, Phase 2	4		2	FLOAT	
40	VA, Phase 3	4		2	FLOAT	
42	VA, Phase Total	4		2	FLOAT	
44	Angle, V1-I1	4	Degree	2	FLOAT	
46	Angle, V1-I2	4		2	FLOAT	
48	Angle, V1-I3	4		2	FLOAT	
50	Power factor, Phase 1	4	%	2	FLOAT	
52	Power factor, Phase 2	4		2	FLOAT	
54	Power factor, Phase 3	**4**		**2**	**FLOAT**	
56	Power factor, Phase Average	4		2	FLOAT	
58	Lline frequency	4	Hz	2	FLOAT	
60	Status Word	4		2	FLOAT	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
61	Status Word	4		1	U16	
62	Current, Phase 1	4		2	U16	
63	Current, Phase 2	4		2	U16	
64	Current, Phase 3	4		2	U16	
65	Current, Phase Total	4		2	U16	
66	Reserved	4		2	U16	
67	Reserved	4		2	U16	
68	Voltage, Phase 1	4		2	U16	
69	Voltage, Phase 2	4		2	U16	
70	Voltage, Phase 3	4		2	U16	
71	Voltage, Phase Total Average	4		2	U16	
72	Watt, Phase 1	4		2	U16	
73	Watt, Phase 2	4		2	U16	
74	Watt, Phase 3	4		2	U16	
75	Watt, Phase Total	4		2	U16	
76	Watt/Hr, Phase 1	4	W/HR	2	U32	0 ~ 99,999,999
78	Watt/Hr, Phase 2	4		2	U32	
80		4		2	U32	
82	Watt/Hr, Total	4		2	U32	0 ~ 999,999,999
84	Fundamental Watt/Hr, Phase 1	4	W/HR	2	U32	0 ~ 99,999,999
86	Fundamental Watt/Hr, Phase 2	4		2	U32	
88	Fundamental Watt/Hr, Phase 3	4		2	U32	
90	Fundamental Watt/Hr, Total	4		2	U32	0 ~ 999,999,999
92	Fundamental Watt/Hr, Phase 1	4	VAR/H	2	U32	0 ~ 99,999,999
94	Fundamental Watt/Hr, Phase 2	4		2	U32	
96	Fundamental Watt/Hr, Phase 3	4		2	U32	
98		4		2	U32	0 ~ 999,999,999
100	VA/Hr, Phase 1	4	VA/H	2	U32	0 ~ 99,999,999
102	VA/Hr, Phase 2	4		2	U32	
104	VA/Hr, Phase 3	4		2	U32	
106	VA/Hr, Phase Total	4		2	U32	0 ~ 999,999,999

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
108	VTHD, Phase 1	4		1	U16	0 ~ 39900 (0.00 ~ 399.00 %)
109	VTHD, Phase 2	4		1	U16	
110	VTHD, Phase 3	4		1	U16	
111	VTHD, Phase Average	4		1	U16	
112	ITHD, Phase 1	4		1	U16	0 ~ 39900 (0.00 ~ 399.00 %)
113	ITHD, Phase 2	4		1	U16	
114	ITHD, Phase 3	4		1	U16	
115	ITHD, Average	4		1	U16	
116	Reserved	4		1	U16	
117	Reserved	4		1	U16	
118	Reserved	4		1	U16	
119	Reserved	4		1	U16	
Configuration						
120	Time Stamp	4.16		3	TS	
123	Reserved	4.6		1	U16	
124	Reserved	4.6		1	U16	
125	Connection Type	4.6		1	U16	0:3P4W, 1:3P3W, 2:1P3W, 3:1P2W
126	# of CT Turn	4.6		1	U16	1 ~ 10(default:1)
127	CT Ratio	4.6		1	U16	1 ~ 65535(default:100)
128	PT Ratio	4.6		1	U16	1 ~ 65535(default:220)
129	Demand Period	4.6		1	U16	1/5/10/15/30/60(default:15)
130	ZERO Power	4.6		1	U16	1 ~ 20(0.0001%~0.002%, default:10)
131	Reserved	4.6		1	U16	
132	Reserved	4.6		2	U32	
134	Reserved	4.6		1	U16	
135	Reserved	4.6		1	U16	
136	Reserved	4.6		1	U16	
137	Reserved	4.6		1	U16	
138	Reserved	4.6		1	U16	
139	Reserved	4.6		1	U16	
140	Reserved	4.6		1	U16	
141	Reserved	4.6		1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
142	Reserved	4,6		1	U16	
143	Reserved	4,6		1	U16	
144	Reserved	4,6		1	U16	
145	Reserved	4,6		1	U16	
146	Reserved	4,6		1	U16	
147	Reserved	4,6		1	U16	
148	Reserved	4,6		1	U16	
149	Reserved	4,6		1	U16	
Demand						
150	Time Stamp	4		3	TS	
153	Reserved	4		1	U16	
154	Volt Demand, Phase 1	4		2	FLOAT	
156	Volt Demand, Phase 2	4		2	FLOAT	
158	Volt Demand, Phase 3	4		2	FLOAT	
160	Current Demand, Phase 1	4		2	FLOAT	
162	Current Demand, Phase 2	4		2	FLOAT	
164	Current Demand, Phase 3	4		2	FLOAT	
166	Watt Demand	4		2	FLOAT	
168	Var Demand	4		2	FLOAT	
170	VA Demand	4		2	FLOAT	
172	Reserved	4		2	FLOAT	
174	Cumulative Watt Demand	4		2	FLOAT	
176	Cumulative Var Demand	4		2	FLOAT	
178	Cumulative VA Demand	4		2	FLOAT	
180	Min. Volt, Phase 1	4		2	FLOAT	
182	Min. Volt, Phase 2	4		2	FLOAT	
184	Min. Volt, Phase 3	4		2	FLOAT	
186	Max. Current, Phase 1	4		2	FLOAT	
188	Max. Current, Phase 2	4		2	FLOAT	
190	Max. Current, Phase 3	4		2	FLOAT	
192	Max. Demand Watt	4		2	FLOAT	
194	Max. Demand Var	4		2	FLOAT	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
196	Max Demand VA	4		2	FLOAT	
198	Reserved	4		1	U16	
200	Reserved	4		1	U16	
202	Reserved	4		1	U16	
204	Reserved	4		1	U16	
206	Reserved	4		1	U16	
207	Reserved	4		1	U16	
208	Reserved	4		1	U16	
209	Reserved	4		1	U16	
	Harmonic					
210	2nd VHD, Phase 1	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
211	2nd VHD, Phase 2	4	%	1	U16	
212	2nd VHD, Phase 3	4	%	1	U16	
213	2nd IHD, Phase 1	4	%	1	U16	
214	2nd IHD, Phase 2	4	%	1	U16	
215	2nd IHD, Phase 3	4	%	1	U16	
216	3rd VHD, Phase 1	4	%	1	U16	
217	3rd VHD, Phase 2	4	%	1	U16	
218	3rd VHD, Phase 3	4	%	1	U16	
219	3rd IHD, Phase 1	4	%	1	U16	
220	3rd IHD, Phase 2	4	%	1	U16	
221	3rd IHD, Phase 3	4	%	1	U16	
222	4th VHD, Phase 1	4	%	1	U16	
223	4th VHD, Phase 2	4	%	1	U16	
224	4th VHD, Phase 3	4	%	1	U16	
225	4th IHD, Phase 1	4	%	1	U16	
226	4th IHD, Phase 2	4	%	1	U16	
227	4th IHD, Phase 3	4	%	1	U16	
228	5th VHD, Phase 1	4	%	1	U16	
229	5th VHD, Phase 2	4	%	1	U16	
230	5th VHD, Phase 3	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
231	5th IHD, Phase 1	4	%	1	U16	
232	5th IHD, Phase 2	4	%	1	U16	
233	5th IHD, Phase 3	4	%	1	U16	
234	6th VHD, Phase 1	4	%	1	U16	
235	6th VHD, Phase 2	4	%	1	U16	
236	6th VHD, Phase 3	4	%	1	U16	
237	6th IHD, Phase 1	4	%	1	U16	
238	6th IHD, Phase 2	4	%	1	U16	
239	6th IHD, Phase 3	4	%	1	U16	
240	7th VHD, Phase 1	4	%	1	U16	
241	7th VHD, Phase 2	4	%	1	U16	
242	7th VHD, Phase 3	4	%	1	U16	
243	7th IHD, Phase 1	4	%	1	U16	
244	7th IHD, Phase 2	4	%	1	U16	
245	7th IHD, Phase 3	4	%	1	U16	
246	8th VHD, Phase 1	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
247	8th VHD, Phase 2	4	%	1	U16	
248	8th VHD, Phase 3	4	%	1	U16	
249	8th IHD, Phase 1	4	%	1	U16	
250	8th IHD, Phase 2	4	%	1	U16	
251	8th IHD, Phase 3	4	%	1	U16	
252	9th VHD, Phase 1	4	%	1	U16	
253	9th VHD, Phase 2	4	%	1	U16	
254	9th VHD, Phase 3	4	%	1	U16	
255	9th IHD, Phase 1	4	%	1	U16	
256	9th IHD, Phase 2	4	%	1	U16	
257	9th IHD, Phase 3	4	%	1	U16	
258	10th VHD, Phase 1	4	%	1	U16	
259	10th VHD, Phase 2	4	%	1	U16	
260	10th VHD, Phase 3	4	%	1	U16	
261	10th IHD, Phase 1	4	%	1	U16	
262	10th IHD, Phase 2	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
263	10th IHD, Phase 3	4	%	1	U16	
264	11th VHD, Phase 1	4	%	1	U16	
265	11th VHD, Phase 2	4	%	1	U16	
266	11th VHD, Phase 3	4	%	1	U16	
267	11th IHD, Phase 1	4	%	1	U16	
268	11th IHD, Phase 2	4	%	1	U16	
269	11th IHD, Phase 3	4	%	1	U16	
270	12th VHD, Phase 1	4	%	1	U16	
271	12th VHD, Phase 2	4	%	1	U16	
272	12th VHD, Phase 3	4	%	1	U16	
273	12th IHD, Phase 1	4	%	1	U16	
274	12th IHD, Phase 2	4	%	1	U16	
275	12th IHD, Phase 3	4	%	1	U16	
276	13th VHD, Phase 1	4	%	1	U16	
277	13th VHD, Phase 2	4	%	1	U16	
278	13th VHD, Phase 3	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
279	13th IHD, Phase 1	4	%	1	U16	
280	13th IHD, Phase 2	4	%	1	U16	
281	13th IHD, Phase 3	4	%	1	U16	
282	14th VHD, Phase 1	4	%	1	U16	
283	14th VHD, Phase 2	4	%	1	U16	
284	14th VHD, Phase 3	4	%	1	U16	
285	14th IHD, Phase 1	4	%	1	U16	
286	14th IHD, Phase 2	4	%	1	U16	
287	14th IHD, Phase 3	4	%	1	U16	
288	15th VHD, Phase 1	4	%	1	U16	
289	15th VHD, Phase 2	4	%	1	U16	
290	15th VHD, Phase 3	4	%	1	U16	
291	15th IHD, Phase 1	4	%	1	U16	
292	15th IHD, Phase 2	4	%	1	U16	
293	15th IHD, Phase 3	4	%	1	U16	
294	16th VHD, Phase 1	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
295	16th VHD, Phase 2	4	%	1	U16	
296	16th VHD, Phase 3	4	%	1	U16	
297	16th IHD, Phase 1	4	%	1	U16	
298	16th IHD, Phase 2	4	%	1	U16	
299	16th IHD, Phase 3	4	%	1	U16	
300	17th VHD, Phase 1	4	%	1	U16	
301	17th VHD, Phase 2	4	%	1	U16	
302	17th VHD, Phase 3	4	%	1	U16	
303	17th IHD, Phase 1	4	%	1	U16	
304	17th IHD, Phase 2	4	%	1	U16	
305	17th IHD, Phase 3	4	%	1	U16	
306	18th VHD, Phase 1	4	%	1	U16	
307	18th VHD, Phase 2	4	%	1	U16	
308	18th VHD, Phase 3	4	%	1	U16	
309	18th IHD, Phase 1	4	%	1	U16	
310	18th IHD, Phase 2	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
311	18th IHD, Phase 3	4	%	1	U16	
312	19th VHD, Phase 1	4	%	1	U16	
313	19th VHD, Phase 2	4	%	1	U16	
314	19th VHD, Phase 3	4	%	1	U16	
315	19th IHD, Phase 1	4	%	1	U16	
316	19th IHD, Phase 2	4	%	1	U16	
317	19th IHD, Phase 3	4	%	1	U16	
318	20th VHD, Phase 1	4	%	1	U16	
319	20th VHD, Phase 2	4	%	1	U16	
320	20th VHD, Phase 3	4	%	1	U16	
321	20th IHD, Phase 1	4	%	1	U16	
322	20th IHD, Phase 2	4	%	1	U16	
323	20th IHD, Phase 3	4	%	1	U16	
324	21st VHD, Phase 1	4	%	1	U16	
325	21st VHD, Phase 2	4	%	1	U16	
326	21st VHD, Phase 3	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
327	21st IHD, Phase 1	4	%	1	U16	
328	21st IHD, Phase 2	4	%	1	U16	
329	21st IHD, Phase 3	4	%	1	U16	
330	22nd VHD, Phase 1	4	%	1	U16	
331	22nd VHD, Phase 2	4	%	1	U16	
332	22nd VHD, Phase 3	4	%	1	U16	
333	22nd IHD, Phase 1	4	%	1	U16	
334	22nd IHD, Phase 2	4	%	1	U16	
335	22nd IHD, Phase 3	4	%	1	U16	
336	23rd VHD, Phase 1	4	%	1	U16	
337	23rd VHD, Phase 2	4	%	1	U16	
338	23rd VHD, Phase 3	4	%	1	U16	
339	23rd IHD, Phase 1	4	%	1	U16	
340	23rd IHD, Phase 2	4	%	1	U16	
341	23rd IHD, Phase 3	4	%	1	U16	
342	24th VHD, Phase 1	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
343	24th VHD, Phase 2	4	%	1	U16	
344	24th VHD, Phase 3	4	%	1	U16	
345	24th IHD, Phase 1	4	%	1	U16	
346	24th IHD, Phase 2	4	%	1	U16	
347	24th IHD, Phase 3	4	%	1	U16	
348	25th VHD, Phase 1	4	%	1	U16	
349	25th VHD, Phase 2	4	%	1	U16	
350	25th VHD, Phase 3	4	%	1	U16	
351	25th IHD, Phase 1	4	%	1	U16	
352	25th IHD, Phase 2	4	%	1	U16	
353	25th IHD, Phase 3	4	%	1	U16	
354	26th VHD, Phase 1	4	%	1	U16	
355	26th VHD, Phase 2	4	%	1	U16	
356	26th VHD, Phase 3	4	%	1	U16	
357	26th IHD, Phase 1	4	%	1	U16	
358	26th IHD, Phase 2	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
359	26th IHD, Phase 3	4	%	1	U16	
360	27th VHD, Phase 1	4	%	1	U16	
361	27th VHD, Phase 2	4	%	1	U16	
362	27th VHD, Phase 3	4	%	1	U16	
363	27th IHD, Phase 1	4	%	1	U16	
364	27th IHD, Phase 2	4	%	1	U16	
365	27th IHD, Phase 3	4	%	1	U16	
366	28th VHD, Phase 1	4	%	1	U16	
367	28th VHD, Phase 2	4	%	1	U16	
368	28th VHD, Phase 3	4	%	1	U16	
369	28th IHD, Phase 1	4	%	1	U16	
370	28th IHD, Phase 2	4	%	1	U16	
371	28th IHD, Phase 3	4	%	1	U16	
372	29th VHD, Phase 1	4	%	1	U16	
373	29th VHD, Phase 2	4	%	1	U16	
374	29th VHD, Phase 3	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
375	29th IHD, Phase 1	4	%	1	U16	
376	29th IHD, Phase 2	4	%	1	U16	
377	29th IHD, Phase 3	4	%	1	U16	
378	30th VHD, Phase 1	4	%	1	U16	
379	30th VHD, Phase 2	4	%	1	U16	
380	30th VHD, Phase 3	4	%	1	U16	
381	30th IHD, Phase 1	4	%	1	U16	
382	30th IHD, Phase 2	4	%	1	U16	
383	30th IHD, Phase 3	4	%	1	U16	
384	31st VHD, Phase 1	4	%	1	U16	
385	31st VHD, Phase 2	4	%	1	U16	
386	31st VHD, Phase 3	4	%	1	U16	
387	31st IHD, Phase 1	4	%	1	U16	
388	31st IHD, Phase 2	4	%	1	U16	
389	31st IHD, Phase 3	4	%	1	U16	
390	32nd VHD, Phase 1	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
391	32nd VHD, Phase 2	4	%	1	U16	
392	32nd VHD, Phase 3	4	%	1	U16	
393	32nd IHD, Phase 1	4	%	1	U16	
394	32nd IHD, Phase 2	4	%	1	U16	
395	32nd IHD, Phase 3	4	%	1	U16	
396	33rd VHD, Phase 1	4	%	1	U16	
397	33rd VHD, Phase 2	4	%	1	U16	
398	33rd VHD, Phase 3	4	%	1	U16	
399	33rd IHD, Phase 1	4	%	1	U16	
400	33rd IHD, Phase 2	4	%	1	U16	
401	33rd IHD, Phase 3	4	%	1	U16	
402	34th VHD, Phase 1	4	%	1	U16	
403	34th VHD, Phase 2	4	%	1	U16	
404	34th VHD, Phase 3	4	%	1	U16	
405	34th IHD, Phase 1	4	%	1	U16	
406	34th IHD, Phase 2	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
407	34th IHD, Phase 3	4	%	1	U16	
408	35th VHD, Phase 1	4	%	1	U16	
409	35th VHD, Phase 2	4	%	1	U16	
410	35th VHD, Phase 3	4	%	1	U16	
411	35th IHD, Phase 1	4	%	1	U16	
412	35th IHD, Phase 2	4	%	1	U16	
413	35th IHD, Phase 3	4	%	1	U16	
414	36th VHD, Phase 1	4	%	1	U16	
415	36th VHD, Phase 2	4	%	1	U16	
416	36th VHD, Phase 3	4	%	1	U16	
417	36th IHD, Phase 1	4	%	1	U16	
418	36th IHD, Phase 2	4	%	1	U16	
419	36th IHD, Phase 3	4	%	1	U16	
420	37th VHD, Phase 1	4	%	1	U16	
421	37th VHD, Phase 2	4	%	1	U16	
422	37th VHD, Phase 3	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
423	37th IHD, Phase 1	4	%	1	U16	
424	37th IHD, Phase 2	4	%	1	U16	
425	37th IHD, Phase 3	4	%	1	U16	
426	38th VHD, Phase 1	4	%	1	U16	
427	38th VHD, Phase 2	4	%	1	U16	
428	38th VHD, Phase 3	4	%	1	U16	
429	38th IHD, Phase 1	4	%	1	U16	
430	38th IHD, Phase 2	4	%	1	U16	
431	38th IHD, Phase 3	4	%	1	U16	
432	39th VHD, Phase 1	4	%	1	U16	
433	39th VHD, Phase 2	4	%	1	U16	
434	39th VHD, Phase 3	4	%	1	U16	
435	39th IHD, Phase 1	4	%	1	U16	
436	39th IHD, Phase 2	4	%	1	U16	
437	39th IHD, Phase 3	4	%	1	U16	
438	40th VHD, Phase 1	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
439	40th VHD, Phase 2	4	%	1	U16	
440	40th VHD, Phase 3	4	%	1	U16	
441	40th IHD, Phase 1	4	%	1	U16	
442	40th IHD, Phase 2	4	%	1	U16	
443	40th IHD, Phase 3	4	%	1	U16	
444	41st VHD, Phase 1	4	%	1	U16	
445	41st VHD, Phase 2	4	%	1	U16	
446	41st VHD, Phase 3	4	%	1	U16	
447	41st IHD, Phase 1	4	%	1	U16	
448	41st IHD, Phase 2	4	%	1	U16	
449	41st IHD, Phase 3	4	%	1	U16	
450	42nd VHD, Phase 1	4	%	1	U16	
451	42nd VHD, Phase 2	4	%	1	U16	
452	42nd VHD, Phase 3	4	%	1	U16	
453	42nd IHD, Phase 1	4	%	1	U16	
454	42nd IHD, Phase 2	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
455	42nd IHD, Phase 3	4	%	1	U16	
456	43rd VHD, Phase 1	4	%	1	U16	
457	43rd VHD, Phase 2	4	%	1	U16	
458	43rd VHD, Phase 3	4	%	1	U16	
459	43rd IHD, Phase 1	4	%	1	U16	
460	43rd IHD, Phase 2	4	%	1	U16	
461	43rd IHD, Phase 3	4	%	1	U16	
462	44th VHD, Phase 1	4	%	1	U16	
463	44th VHD, Phase 2	4	%	1	U16	
464	44th VHD, Phase 3	4	%	1	U16	
465	44th IHD, Phase 1	4	%	1	U16	
466	44th IHD, Phase 2	4	%	1	U16	
467	44th IHD, Phase 3	4	%	1	U16	
468	45th VHD, Phase 1	4	%	1	U16	
469	45th VHD, Phase 2	4	%	1	U16	
470	45th VHD, Phase 3	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
471	45th IHD, Phase 1	4	%	1	U16	
472	45th IHD, Phase 2	4	%	1	U16	
473	45th IHD, Phase 3	4	%	1	U16	
474	46th VHD, Phase 1	4	%	1	U16	
475	46th VHD, Phase 2	4	%	1	U16	
476	46th VHD, Phase 3	4	%	1	U16	
477	46th IHD, Phase 1	4	%	1	U16	
478	46th IHD, Phase 2	4	%	1	U16	
479	46th IHD, Phase 3	4	%	1	U16	
480	47th VHD, Phase 1	4	%	1	U16	
481	47th VHD, Phase 2	4	%	1	U16	
482	47th VHD, Phase 3	4	%	1	U16	
483	47th IHD, Phase 1	4	%	1	U16	
484	47th IHD, Phase 2	4	%	1	U16	
485	47th IHD, Phase 3	4	%	1	U16	
486	48th VHD, Phase 1	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
487	48th VHD, Phase 2	4	%	1	U16	
488	48th VHD, Phase 3	4	%	1	U16	
489	48th IHD, Phase 1	4	%	1	U16	
490	48th IHD, Phase 2	4	%	1	U16	
491	48th IHD, Phase 3	4	%	1	U16	
492	49th VHD, Phase 1	4	%	1	U16	
493	49th VHD, Phase 2	4	%	1	U16	
494	49th VHD, Phase 3	4	%	1	U16	
495	49th IHD, Phase 1	4	%	1	U16	
496	49th IHD, Phase 2	4	%	1	U16	
497	49th IHD, Phase 3	4	%	1	U16	
498	50th VHD, Phase 1	4	%	1	U16	
499	50th VHD, Phase 2	4	%	1	U16	
500	50th VHD, Phase 3	4	%	1	U16	
501	50th IHD, Phase 1	4	%	1	U16	
502	50th IHD, Phase 2	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
503	50th IHD, Phase 3	4	%	1	U16	
504	51st VHD, Phase 1	4	%	1	U16	
505	51st VHD, Phase 2	4	%	1	U16	
506	51st VHD, Phase 3	4	%	1	U16	
507	51st IHD, Phase 1	4	%	1	U16	
508	51st IHD, Phase 2	4	%	1	U16	
509	51st IHD, Phase 3	4	%	1	U16	
510	52nd VHD, Phase 1	4	%	1	U16	
511	52nd VHD, Phase 2	4	%	1	U16	
512	52nd VHD, Phase 3	4	%	1	U16	
513	52nd IHD, Phase 1	4	%	1	U16	
514	52nd IHD, Phase 2	4	%	1	U16	
515	52nd IHD, Phase 2	4	%	1	U16	
516	53rd VHD, Phase 1	4	%	1	U16	
517	53rd VHD, Phase 2	4	%	1	U16	
518	53rd VHD, Phase 3	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
519	53th IHD, Phase 1	4	%	1	U16	
520	53th IHD, Phase 2	4	%	1	U16	
521	53th IHD, Phase 3	4	%	1	U16	
522	54th VHD, Phase 1	4	%	1	U16	
523	54th VHD, Phase 2	4	%	1	U16	
524	54th VHD, Phase 3	4	%	1	U16	
525	54th IHD, Phase 1	4	%	1	U16	
526	54th IHD, Phase 2	4	%	1	U16	
527	54th IHD, Phase 3	4	%	1	U16	
528	55th VHD, Phase 1	4	%	1	U16	
529	55th VHD, Phase 2	4	%	1	U16	
530	55th VHD, Phase 3	4	%	1	U16	
531	55th IHD, Phase 1	4	%	1	U16	
532	55th IHD, Phase 2	4	%	1	U16	
533	55th IHD, Phase 3	4	%	1	U16	
534	56th VHD, Phase 1	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
535	56th VHD, Phase 2	4	%	1	U16	
536	56th VHD, Phase 3	4	%	1	U16	
537	56th IHD, Phase 1	4	%	1	U16	
538	56th IHD, Phase 2	4	%	1	U16	
539	56th IHD, Phase 3	4	%	1	U16	
540	57th VHD, Phase 1	4	%	1	U16	
541	57th VHD, Phase 2	4	%	1	U16	
542	57th VHD, Phase 3	4	%	1	U16	
543	57th IHD, Phase 1	4	%	1	U16	
544	57th IHD, Phase 2	4	%	1	U16	
545	57th IHD, Phase 3	4	%	1	U16	
546	58th VHD, Phase 1	4	%	1	U16	
547	58th VHD, Phase 2	4	%	1	U16	
548	58th VHD, Phase 3	4	%	1	U16	
549	58th IHD, Phase 1	4	%	1	U16	
550	58th IHD, Phase 2	4	%	1	U16	

Word Address	Name	FC	Unit	Word Size	Data Type	Comment
551	58th IHD, Phase 3	4	%	1	U16	
552	59th VHD, Phase 1	4	%	1	U16	
553	59th VHD, Phase 2	4	%	1	U16	
554	59th VHD, Phase 3	4	%	1	U16	
555	59th IHD, Phase 1	4	%	1	U16	
556	59th IHD, Phase 2	4	%	1	U16	
557	59th IHD, Phase 3	4	%	1	U16	
558	60th VHD, Phase 1	4	%	1	U16	
559	60th VHD, Phase 2	4	%	1	U16	
560	60th VHD, Phase 3	4	%	1	U16	
561	60th IHD, Phase 1	4	%	1	U16	
562	60th IHD, Phase 2	4	%	1	U16	
563	60th IHD, Phase 3	4	%	1	U16	
564	61st VHD, Phase 1	4	%	1	U16	
565	61st VHD, Phase 2	4	%	1	U16	
566	61st VHD, Phase 3	4	%	1	U16	0 ~ 39900(0.00 ~ 399.00%)
567	61st IHD, Phase 1	4	%	1	U16	
568	61st IHD, Phase 2	4	%	1	U16	
569	61st IHD, Phase 3	4	%	1	U16	
570	62nd VHD, Phase 1	4	%	1	U16	
571	62nd VHD, Phase 2	4	%	1	U16	
572	62nd VHD, Phase 3	4	%	1	U16	
573	62nd IHD, Phase 1	4	%	1	U16	
574	62nd IHD, Phase 2	4	%	1	U16	
575	62nd IHD, Phase 3	4	%	1	U16	
576	63rd VHD, Phase 1	4	%	1	U16	
577	63rd VHD, Phase 2	4	%	1	U16	
578	63rd VHD, Phase 3	4	%	1	U16	
579	63rd IHD, Phase 1	4	%	1	U16	
580	63rd IHD, Phase 2	4	%	1	U16	
581	63rd IHD, Phase 3	4	%	1	U16	

1.4 Energy Register

Accumulative energy registers have the total consumed energy calclated by EMU. The command word(register 91) resets the accumulative energy and the demand register.

Active, reactive, and apparent energy consumption values are stored as 32-bit values, thus using 2 Modbus registers.

The lower register address contains the high word value (MSW : Most Significant Word) and the high register contains the low word value (LSW : Least Significant Word).

0	1
16-bits	16-bits
MSW	LSW

1.5 Energy Counter Time Stamp Register

A changed time value is registered in Energy Counter Register.

Each of the registers is split into two parts as shown in the following table.

Register		High Byte	Low Byte
24	28	Minute	Second
25	29	Day	Hour
26	30	Year	Month

1.6 RMS Register

It sores average RMS value once which reads every 60 cycles in 1 second (1 second in the 60Hz system). The data format follow the IEEE 754 Floating Point.

1.7 Power Register

The metering unit of active/reactive/apparent power are 1W, 1Var, 1VA each. The data format follows the IEEE 754 Floating Piont.

1.8 Frequency

The Line Frequency is measured based on the phase of the power supply only (phase L1). The lastest value is stored in this register.

The Metering unit is 0.01Hz.

1.9 Angle

It is a phase angle between phase voltage and phase current.

The metering uit is 0.01°.

1.10 Status word

The status of the EMU can be read from a read-only register.

Bit	Status Description
0	phase L1 voltage is missing.
1	phase L1 voltage is missing.
2	phase L1 voltage is missing.
3	total kWh is reverse.
4	Wiring is wrong.
5	Time Synchronization is required
6	Set when synchronized it 50/60Hz

1.11 RSSI

RSSI means receiving radio signal intensity. the unit is -dBm.

1.12 Present Date/Time

It is present time. The format is same with Time Stamp Register. Use the function code 17 to set the time.

1.13 Connection

Value	Description
0	3P4W
1	1P2W
2	2P3W
3	3P3W

The value number is the power system for Wi-GEM to be connected.

1.14 CT Type

Input the CT rating to be used. For example the primary CT ratio is 100A, input the value 100. 300A input the value 300.

1.15 PT Type

Input the PT rating to be used, if a PT is used. In case of no PT used, Input the PT ratio value of 1. For other PT ratio, Input the primay value of PT responding to the 220V secondary of PT. For example, if the PT ratio is 3300V/110V, Input the value of 6600.

1.16 Recording Interval Time

Supported interval times are 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 minute.
The start of an interval is at the hour + each interval.

1.17 Command Word

The EMU can execute the reset commands to the accumulated energy and demand value which is mapped to a R/W register. Setting a bit in the command word executes the command.

Value	Description
0	Clear the demand registers.
1	Clear the accumulative energies registers.
2	Clear the accumulative energies registers and the demand registers.

1.18 Recording Interval Time Stamp

It means the time when the recording interval based energy is generated.

1.19 Recording Interval-based Energy

Energy is cumulated based on the recording ttime interval that is configurable.

Supprted interval times are 1, 2, 3, 4, 5, 6, 10, 15, 20 , 30, and 60 minute.

The last completed intervla values are sotred in the register map

The start of an interal is implemented at the time of the hour+each interval.

1.20 Maximum current in Interval

The maximum current value is recorded during Recording Interval.

1.21 Minimum voltage in Interval

The minimum voltage value is recorded during Recording Interval.

1.22 Average Power Factor in Interval

Average power factor is calculated based on the recording time interval that is configurable.

1.23 Average Harmonic Reactive Power in Interval

Harmonics Reacive Power = (Total-Fundamental)/Fundamental

1.24 Max Power (Demand Register)

It updates the value of max power when the recording interval data is created every time.

1.25 Max Power Time Stamp

It records the time when the Demand Register updates.

2. EMR related

The related parameters and functions are :

Function/Setting	Description
Number of connectable EMUs	200 EMUs
Selectable Baus Rate	250 kbps

3. EMC related

The related parameters and functions are :

Function/Setting	Description
Number of connectable EMUs or EMRs	200 EMUs or EMRs
Selectable Baus Rate	250 kbps

3.1 Serial Port

Signal Name	Pin Number
3, 6	GND
4	TX
5	RX

3.2 Modbus Protocol

Modbus ID	255
Baud Rate	115200
Parity	None
Stop bit	1
Data Size	8

3.3 Modbus Register Tableused

Modbus Register	Description	Type/ Length	Storage	Unit after Scaling	Access
Energy Register					
0	Energy Register				
1	Energy Register				
2	Energy Register				
3	Energy Register				
4	Energy Register				
5	Operating Channel	U16	V		R
6	Energy Register				
7	Energy Register				
8	Save Mac Table				W
9	Energy Register				
10	Energy Register				
11	Energy Register				
12	Energy Register				
13	Energy Register				
14	Energy Register				
15	Energy Register				W
16	Energy Register				
17	Energy Register				
18	Energy Register				
19	Energy Register				
20	EMU #0 Mac Address	MAC	NV		R
21					
...	...	...	...	...	...
218	EMU #199 Mac Address	MAC	NV		R
219					

3.4 Mac Address Format

Value	High Byte	Low Byte	Description
0	MAC1	MAC0	
1	Modbus ID	MAC2	

4. Communication protocol

For the communication protocol, the Modus RTU method has been adopted. The following lists the basic functions:

Code	Description
03	Multiple registers (read)
06	Single register (write)
16	Multiple register (write)

4.1 Frame structure of multiple registers for read

When requested to Wi-GEM, the frame structure is as follows :

Station Address	Function (03)	Starting Address		Word Count		Error Check	
		High Byte	Low Byte	High Byte	Low Byte	High Byte	Low Byte
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

When replied by Wi-GEM, the frame structure is as follows :

Station Address	Function (03)	Byte Count	Data Word 1		...	Data Word 52		Error Check	
			High Byte	Low Byte		High Byte	Low Byte	High Byte	Low Byte
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	...	1 Byte	1 Byte	1 Byte	1 Byte

4.2 Frame structure of single register for write

When requested to Wi-GEM, the frame structure of the force coil register is as follows :

Station Address	Function (06)	DO Address		Force Data Value		Error Check	
		High Byte	Low Byte	High Byte	Low Byte	High Byte	Low Byte
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte

When replied by Wi-GEM, it returns the frame that is requested to Wi-GEM in case of write success.

Troubleshooting

Symptom		Corrective Action
There is no measured data displayed in the monitoring program.		1. Check the cable connection status. 2. Check the communication port status. 3. Check the communication speed.
Wrong Measurement	Voltage Error	1. Check the cable wiring status. 2. Check the input voltage
	Current Error Or Watt/VAR Error	1. Check the sensor wiring status. 2. Check the current flow of the sensor. 3. Check whether the sensor is open.
Power Operation Error		Check the input voltage.

DANGER

When the abobe-mentioned actions cannot solve the problem, contact with the manufacturer or purchasing agent. In case of product disassembly or modification, it may cause personal damage due to product failure. In this case, you cannot receive warranty services.

Specifications

1. EMU specifications

Item	Specification
Frequency	50/60 Hz
Operating temperature	-10 to 55˚C
Storage temperature	-25 to 85˚C
Weight	160g except clamp (s)
Size	66(W) x 117 (D) x 40 (H) mm

2. EMR & EMC specifications

Item	Specification
Operating temperature	-10 to 55˚C
Storage temperature	-25 to 85˚C
Weight	125g
Size	80(W) x 120 (D) x 23 (H) mm

3. Measurement Information

Item	Instantaneous Values				Interval-based Values				ACumulated Values			
	L1	L2	L3	Sum	L1/L2/L3			Sum	L1	L2	L3	Sum
					Av	Min	Max					
Current (A) Irms	○	○	○	○				○				
Voltage (V) Vrms	○	○	○	○			○					
Active Energy (kWh)									○	○	○	○
Rective Energy (kVARh)									○	○	○	○
Apparent Energy (kVAh)									○	○	○	○
Power Factor(%)	○	○	○	○	○							
Frequency(Hz) 는 R상만 계측하고 S, T 에 동시에 표시한다.	○											
Active Power (kW)	○	○	○	○	○							
Reactive Power (kVAR)	○	○	○	○	○							
Apparent Power (kVA)	○	○	○	○	○							
Hamornic power ratio	○	○	○									
Voltage THD	○	○	○		○							
Current THD	○	○	○		○							
Individual Harmonics 2^{nd}~ 63^{rd}	○	○	○		○							

Manufacturer Information

1. Manufacturer

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2. Documents and others

- User Guide revision 1.00
- Monitoring Program version 1.00
- Modbus Register Map revision 2.30
- Last modification date : 2011. 10. 10